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1.1 Documentation Presentation

This documentation is designed for users wishing to install a FIPIO fieldbus. The complete documentation set is structured as follows :

This Reference Manual

- Operating principles of the FIPIO bus,
- Bus installation and testing principles,
- Operation, adjustment and diagnostic possibilities,
- Technical characteristics of the FIPIO bus,
- Terminology including a glossary of terms.

Specialized User's Manuals for each device that can be connected on FIPIO, covering :

- Description of the product,
- Installation or connection of each device on the bus,
- Use with integrated software,
- Diagnostic possibilities.

The FIPIO bus connects to Hirschmann fiber optic transceivers. Architectures and special conditions relating to configuration are presented in the installation documentation for these devices.

1.2 Schneider Automation's FIPIO Product Line

Schneider Automation offers various products for decentralizing peripherals, intelligent devices and services for long distance data exchange. These products are as follows :

- The FIPIO fieldbus for sensors, preactuators and terminals, for use with the TSX Premium series. 128 stations can be connected on the bus, which has a maximum length of 15 km.
- TSX Series 7 and April Series 1000 PLCs can be connected to the FIPIO bus managed by a TSX Premium PLC. See the specialized document for connection of these devices : TSX DR FPW.

The FIPIO fieldbus is fully compatible with the FIP and WORLDVIP standards.

FIP : according to UTE standard : C46 604

FIPIO is profile 2 of the WORLDVIP standard.

The physical layer of WORLDVIP is standardized IEC1158-2. WORLDVIP has been chosen for the European standard EN.50170

1.2-1 About the FIP/Worldvip Standard

FIP or Worldvip is a set of standards that has been tailored to the "realtime" communication requirements for the implementation of reflex automation systems.

The communication architecture has been reduced to three layers plus the network management function. It complies with the special requirements of fieldbuses and cell networks.

FIP is based on the principle of data broadcasting. Data exchange takes place as follows :

- A call is sent by the bus manager (called the bus arbitrator) to all stations and is addressed to a producer subscriber and all consumers concerned,
- A response is broadcast by this producer subscriber to all stations and can be used by all consumer subscribers.

WORLDVIP offers two types of application service :

- **A distributed database** (cyclic variables) which is exchanged periodically between the devices connected to the network and does not require application programs. This information is available to all consumers at the same time, thus providing consistent data and facilitating synchronization between devices,
- **A message handling system** which, on request, sends messages in point-to-point mode or in broadcast mode. This is very useful for configuration, adjustment, diagnostics and maintenance of intelligent sensors and preactuators as well as for supervisory control and man-machine interface functions.

1.2-2 The FIPIO Fieldbus

FIPIO is a fieldbus used with TSX Premium, Series 7 or Series 1000 PLCs. With this bus, the inputs / outputs of the PLC and its industrial peripheral device can be decentralized and located close to the operating equipment.

FIPIO uses cyclic variables to refresh remote I/O status. This operation is performed at the same rate as the PLC cycle.

The variables and the aperiodic message system are used for all configuration, adjust, diagnostic and man-machine interface functions.

No special skills are needed to develop an application that uses FIPIO fieldbuses. The designer only has to declare the devices connected to each bus in the software, like the procedure used for rack-mounted I/O modules. PL7 automatically generates the network operating parameters which are then downloaded into the PLC. A series of screens will help the operator with the configuration and adjustment of devices connected to the bus.

On TSX Premium PLCs, during start-up or when maintenance is being carried out on the installation, the programming terminals can be connected to any point of the FIPIO bus. All the software services are available immediately : programming, debugging, adjustment, etc. The terminals can be connected to and disconnected from the fieldbus without having any effect on operation. If the programming console is connected to priority address point 63, it can use the software services of the PLC controlling the FIPIO bus as well as any other remote PLC connected to the network. This is achieved through the transparency of the X-WAY communication architecture.

Operation of the installation is made easy by connecting one or more TSX CCX 17 panels, located as close to the operating equipment as possible, at any point on the fieldbus.

The wide range of TBX, Momentum, or FIPIO agent PLC remote I/O modules available means that the interfaces connected to the FIPIO fieldbus are tailored to meet the requirements of each type of installation.

The FIPIO bus can also be used to connect third party devices using predefined standard profiles. These products all come under the banner of the FIPCONNECT standard. Here is a non-exhaustive list for each type of industrial peripheral device :

- pneumatic valves : FESTO, JOUCOMATIC, PARKER,
- screw driving machines : G. RENAULT,
- welding machines : ARO,
- robots and axis controllers : ATLAS COPCO, FANUC, KUKA,
- display units : AMS-E.

2.1 General

In order to create a FIPIO architecture which will allow the different devices to be connected, Schneider Automation can provide the following :

- TSX FP CAxxx single pair cable, available in lengths of 100, 200 or 500 meters,
- TSX FP CRxxx single pair cable, available in lengths of 100, 200 or 500 meters,
- TSX FP CFxxx single pair cable plus two power supply conductors, available in lengths of 100, 200 or 500 meters,
- two-pair cable TSX FP CCxxx, available in lengths of 100, 200 or 500 m,
- TSX FP CE 030 cable for connecting terminals,
- TSX FP CG 010/030 cable for connecting TSX FPP10 and FCP FPP10 PCMCIA cards,
- TSX FP ACC2 or TSX FP ACC12 connector for extension or drop connection of any device with a WORLDFIP 9-pin Sub-D connector,
- CCX 17 operator panel or any other device compatible with the FIPIO communication profile,
- TSX FPP 20 PCMCIA cards for inclusion in TFTX 417-40 terminals,
- TSX BLP 01 connector for connecting TBX distributed I/O interfaces (IP20),
- TBX BLP 10 connector for connecting dust and damp proof TBX distributed I/O interfaces (IP65),
- TBX BAS 10 connector for supplying dust and damp proof TBX output modules,
- TSX FP ACC4 dust and damp proof tap (IP65),
- TBX FP ACC14 standard tap (IP65),
- TBX FP ACC10 dust and damp proof tap (IP65) with remote power supply,
- TSX FP ACC7 line terminator.

TSX FP CA xxx and TSX FP CC xxx cables can only be used for applications inside buildings, in standard conditions.

TSX FP CR xxx and TSX FP CF xxx cables are used to set up installations out of doors or in locations where they may be subject to harsh environmental conditions (chemical, climatic or mechanical). For further details, see the table in part D.

TSX FP CE 030 and TSX FP CG 010 / 030 cables are connected onto a segment via a TSX FP ACC4 tap, using only the plug-in connector (9-pin Sub-D).

Other devices can be connected to a segment as follows :

- By extension with each device being connected to the previous one by the trunk cable or by the remote power cable (IP65)
- By means of a drop line with each device being drop-connected to the trunk cable via a TSX FP ACC4 or TBX FP ACC14 or TBX FP ACC10 tap, or by the double pair tap cable TSX FP CCxxx, or by two TSX FP CA/CRxxx single pair cables,
- Using a combination of the above which comprises devices connected by extension and by drop cable.

A FIPIO bus consists of one or more segments connected together by repeaters.

The maximum length of a bus segment is 1000 meters and the maximum number of stations per segment is 32 (plus any repeaters).

By using electrical or fiber optic repeaters, the length of the FIPIO bus can be extended to 15000 m.

To connect more devices or for lengths greater than 1000 meters, TSX FP ACC6 electrical repeaters or TSX FP ACC8 fiber optic repeaters must be used. The repeater is connected to each segment by extension or using a drop cable.

Redundancy or withstand to severe environments : fiber optic cable connectors are also available, for creation of architectures in a double fiber optic ring. See the User Manual for OZD FIP : TSX DMOZD 01E for fiber optic connectors.

2.2 Number of discrete TBXs (IP65) supported by the drop cable and TSX FP CFxxx 24VDC power cable

The number of discrete TBXs (IP65) depends on the length of the line in meters, the gauge of the electrical conductors which make up the line cable and the precision of the power supply.

The **gauge** used for the power supply conductors in this cable is **AWG 18**.

The various parameters are summarized in the two tables below. They are only valid for the discrete TBX product references (IP65).

a) For a 24 VDC power supply at **5%**

Number of TBXs	1	2	3	4	5	6	7	8	9	10
Length of the line in meters	318	157	103	76	60	49	44	38	31	27

b) For a 24 VDC power supply at **10%**

Number of TBXs	1	2	3	4	5	6	7	8	9	10
Length of the line in meters	222	109	71	52	40	33	27	23	20	18

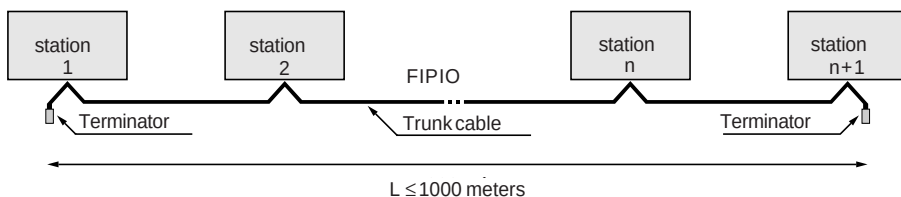
2.3 Types of Connection

2.3-1 Extension

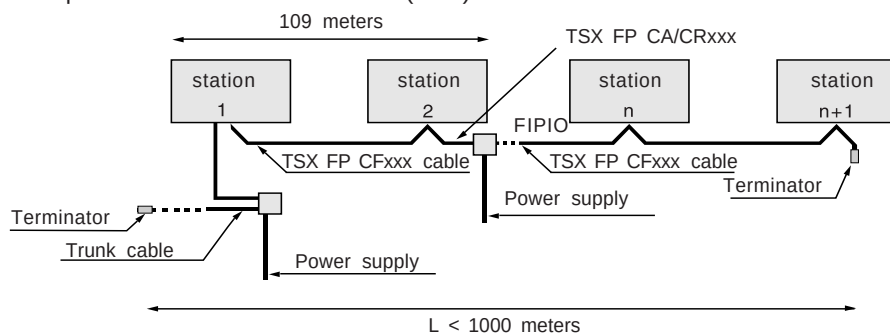
A FIPIO fieldbus can be installed by direct connection point to connection point extension, using the TSX FP CA/CRxxx trunk cable or the TSX FP CFxxx remote power cable. The maximum length of a segment will then be 1000 meters.

Both ends of each segment must be fitted with a TSX FP ACC7 line terminator.

Example of an extension connection (IP20)



Example of an extension connection (IP65)



The TBX FP ACC10 tap must be used here for connecting the power supply (for IP 65 dust and damp proof protection).

The number of TBX used and the accuracy of the power supply determine the length of segment beyond which another TSX FP ACC10 and its power supply should be added (see section 2.2).

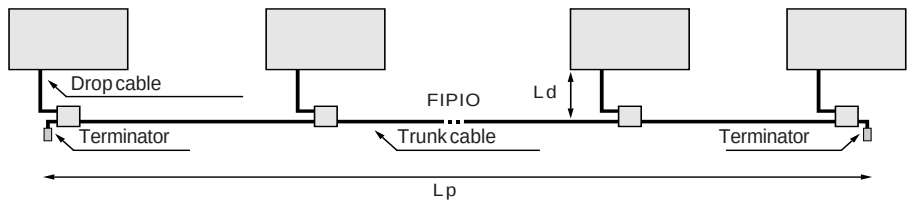
2.3-2 Drop Connection (TSX FP CCxxx drop cable)

A FIPIO fieldbus can be installed by using the TSX FP CA/CRxxx trunk cable and TSX FP ACC4 or TSX FP ACC14 taps. The stations are drop connected using TSX FP CCxx drop cables (this cable contains two shielded twisted pairs).

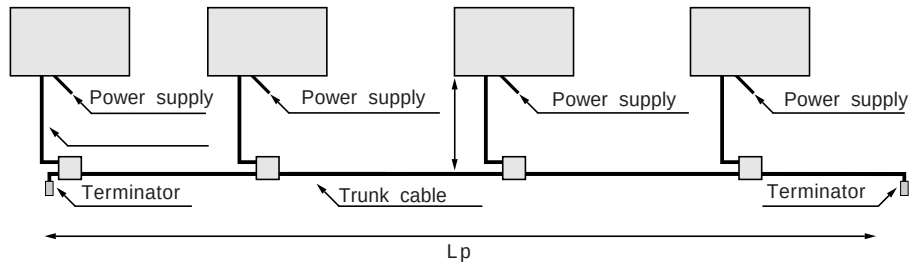
Each segment must be fitted at both ends with a TSX FP ACC7 line terminator. The maximum length of the segment is given by the following relation :

$$L_p + 3\sum L_d \leq 1000 \text{ m.}$$

Example of a drop connection using the TSX FP CCxxx drop cable



TSX FP ACC4 or TBX FP ACC10 taps must be used to connect devices which use TSX FPP 10 or FCP FPP 10 PCMCIA cards. A TSX FP ACC4 is also used to connect programming terminals fitted with a TSX FPP 10, TSX FPP 20 or FCP FPP 10 PCMCIA card. The tap protection index is only IP20 when the socket on the front panel is used.



For TBX IP 65, the power supply is connected via the BLP10 connector. The cables are identical to those used for IP 20 drop connections (TSX FP CCxx and TSX FP CA/CRxxx).

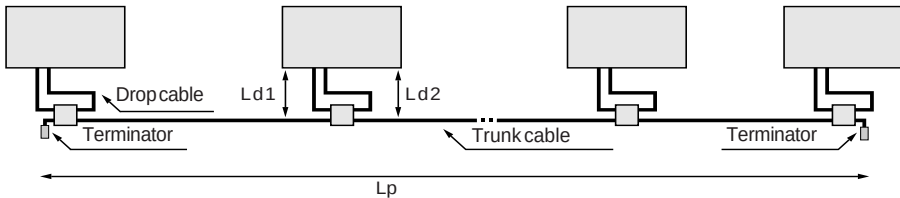
2.3-3 Drop Connection (TSX FP CA/CFxxx drop cable)

An alternative to the previous connection method is to install the TSX FP CA/CRxxx trunk cable and TSX FP ACC4 or TSX FP ACC14 taps. The stations can also be connected using the TSX FP CA/CRxxx trunk cable. Two lengths of drop cable are required for each tap (each cable contains one shielded twisted pair).

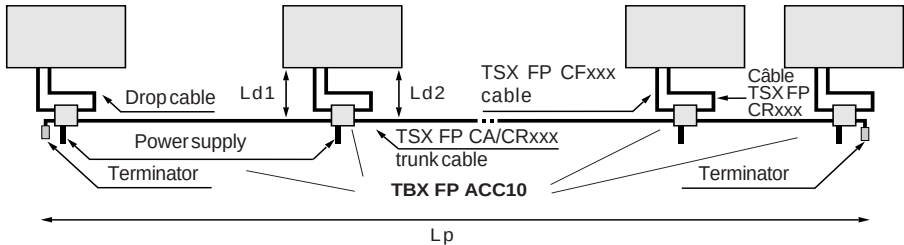
Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of the segment is given by the following relation :

$$L_p + \sum L_{di} \leq 1000 \text{ m.}$$

Example of a drop connection using the TSX FP CA/CR xxx drop cable



Dust and damp proof TBXs (IP65) are drop connected on FIPIO using the TSX FP CRxxx trunk cable and the TSX FP CF remote power cable via TBX FP ACC10 taps.



TBX FP ACC10 taps must be used.

This type of drop connection is the only possible option for installations located out of doors or those subject to particular environmental constraints. In this type of installation, the following cables must be used :

- trunk cable : TSX FP CR xxx
- drop cable :
 - dust and damp proof TBX : TSX FP CF xxx
 - others : TSX FP CR xxx

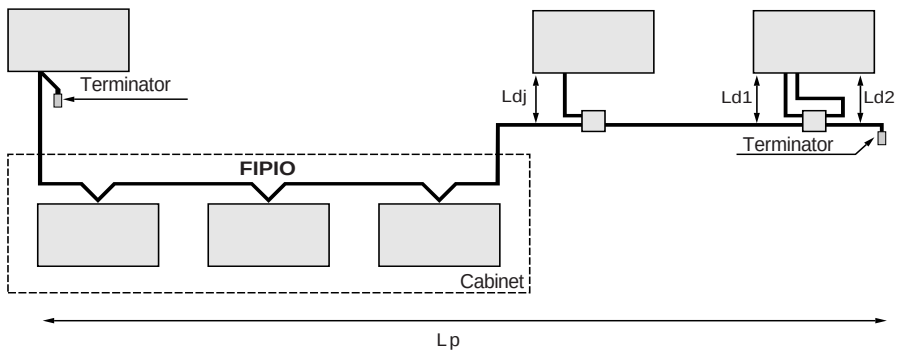
2.3-4 Mixed Connection (extension and drop)

The three connection modes that have already been described can be combined on the same installation. A combination of these types of connection can be used, for example, to connect the devices in an electrical control cabinet to the network with one type of cable.

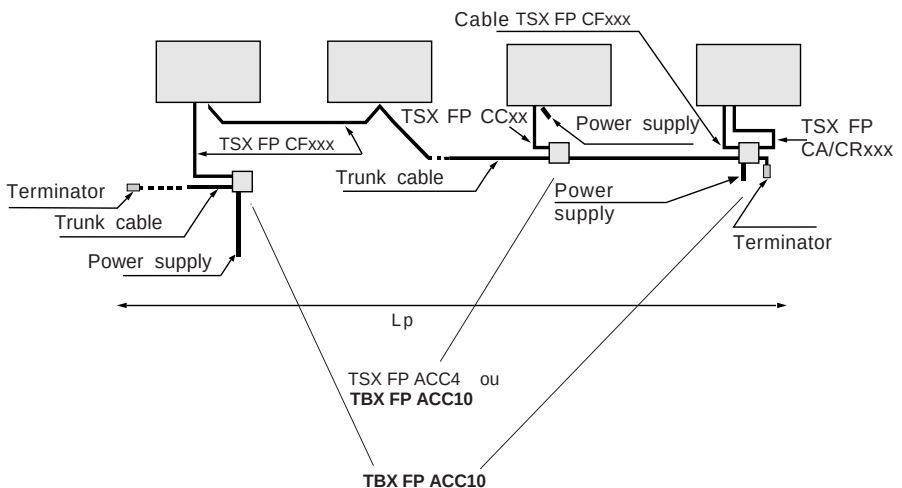
Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of the segment is given by the following relation :

$$L_p + SL_{di} + 3SL_{dj} \leq 1000 \text{ m.}$$

Example of a combined connection (IP20)



Example of a combined connection for dust and damp proof TBXs (IP65)

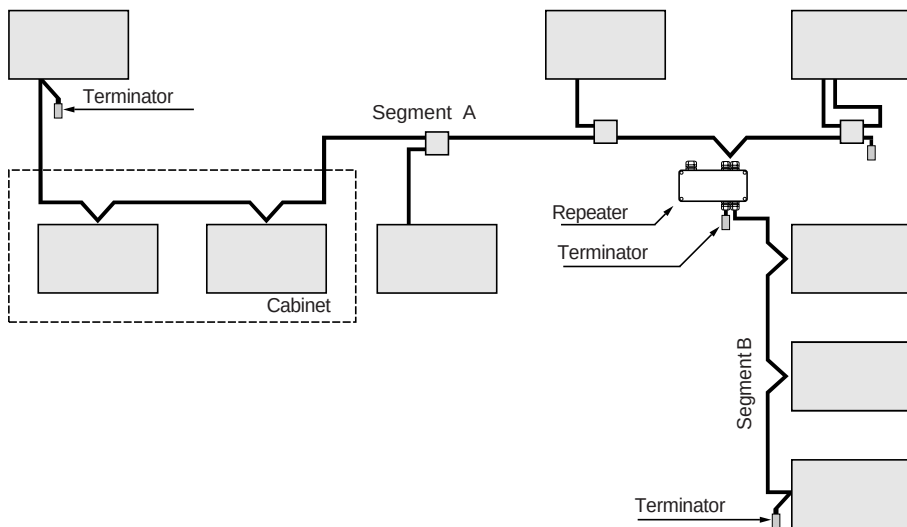


2.3-5 Bus Architecture using a Repeater

The use of a repeater makes it possible to increase the range of the bus and/or to increase the number of connection points. Connection can also be made by extension, drop cable or by a combination of the two.

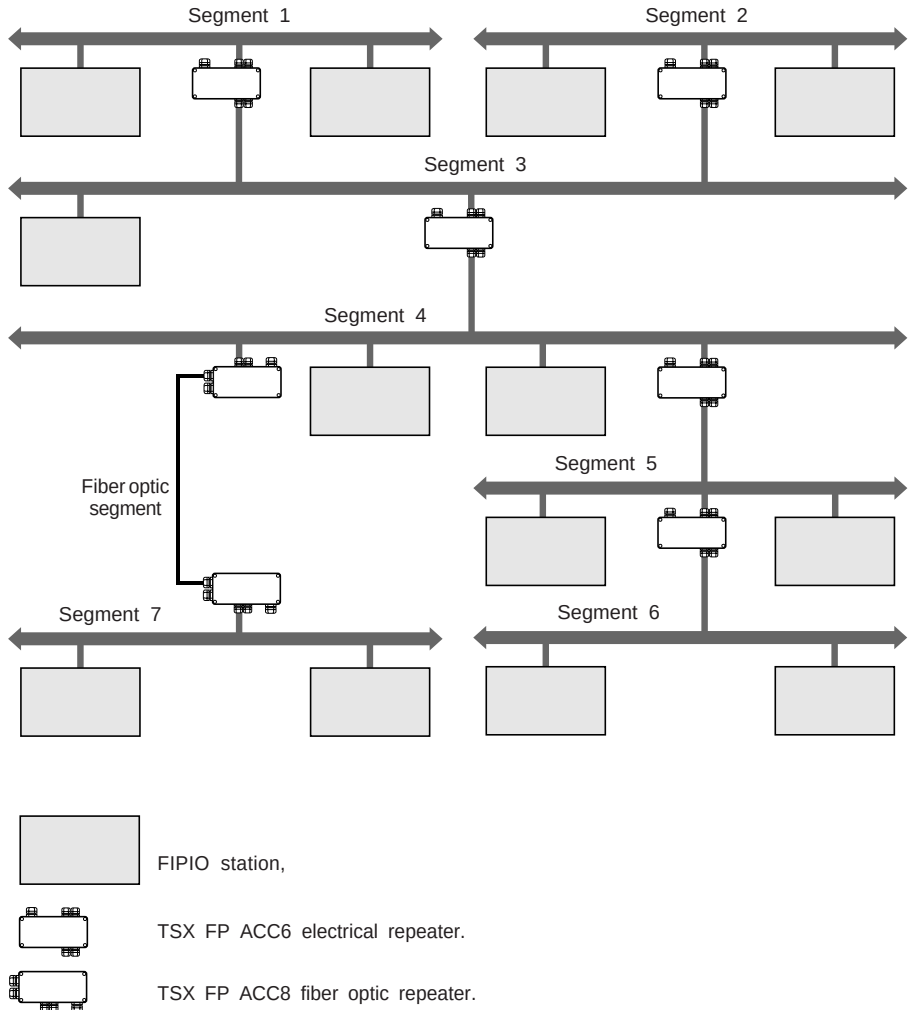
Both ends of each segment must be fitted with a TSX FP ACC7 terminator. The maximum length of each segment is 1000 meters (including drop cables). The length of the trunk cable depends on the type of drop cable used.

Example of architecture

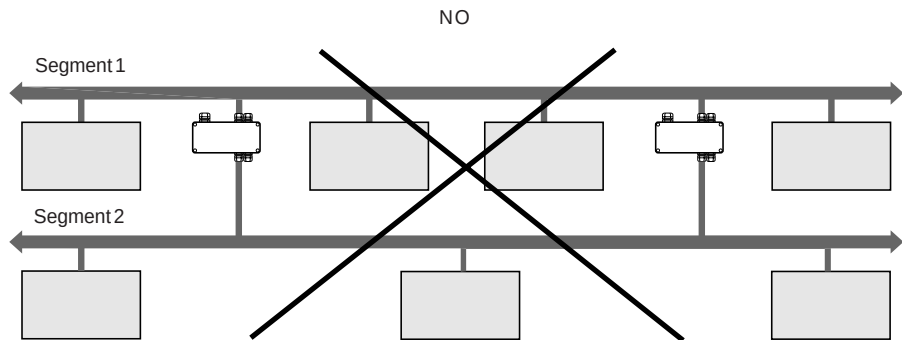


2.3-6 Architecture with Several Repeaters

It is also possible to cascade a maximum of four repeaters per segment in linear or tree type architectures to increase the range of the bus and/or to increase the number of stations connected from 32 to a maximum of 64 (for all segments).



In an architecture that uses several repeaters (electrical and fiber optic), only one path must connect two stations.



FIPIO station



TSX FP ACC6 electrical repeater

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1.1 General

The FIPIO fieldbus is used mainly for sensor and actuator control applications. With this bus, all or part of the control system can be located close to the production site (I/O modules, variable speed drives, identification systems, PC-compatible workshop terminals and operator and control stations).

All devices that can be connected to the FIPIO fieldbus are suitable for :

- TSX 7 Premium /TSX Micro PLCs,
- TBX distributed I/O modules (discrete and analog),
- Momentum remote I/O modules (discrete and analog, intelligent),
- programming terminal,
- supervision and control systems,
- CCX 17 control panel,
- ALTIVAR variable speed drives,
- other FIPIO standard devices manufactured by partners in the FIP-Connect program.

FIPIO supports all the communication services required by automation system engineers with guaranteed I/O refresh time, network transparency and UNI-TE message handling services :

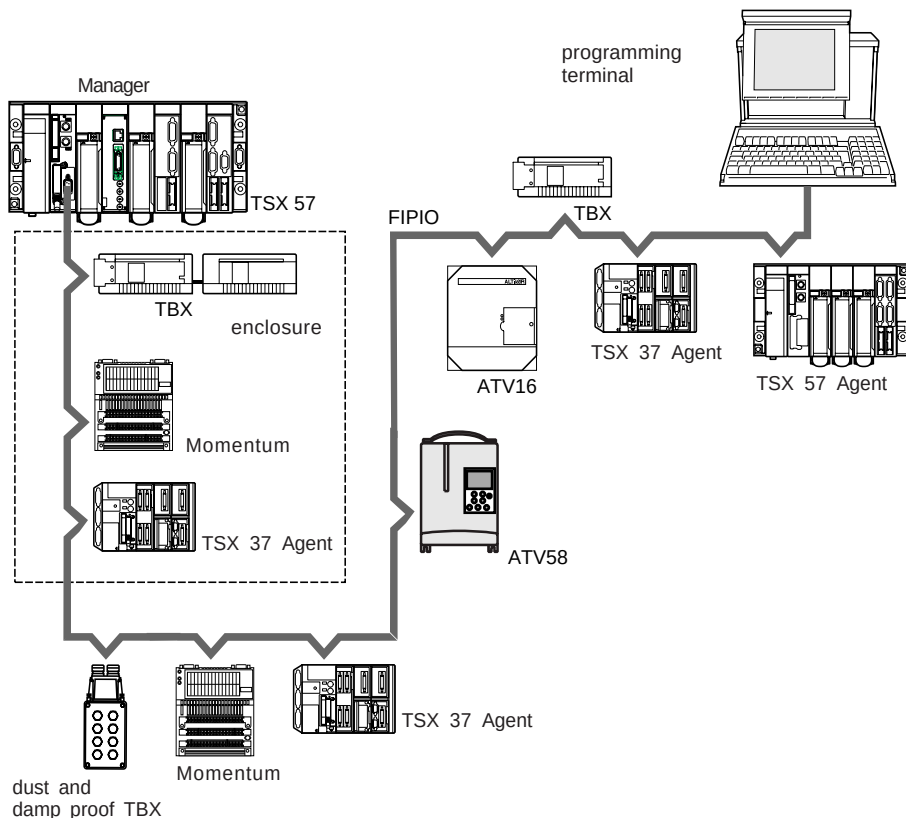
- Priority exchanges on the FIPIO bus are exchanges of input channel acquisition status variables and output channel commands. These exchanges are performed cyclically without any intervention from the application program.
- Other data can also be exchanged on the FIPIO fieldbus such as remote device configuration variables and UNI-TE messages (these services allow the PLC which manages the bus to send parameters to other devices).

The FIPIO fieldbus can be used in several ways :

- In a simple architecture (single station),
- In a more complex architecture (multistation) where several FIPIO segments can be governed by a higher level local network such as Ethernet TCP-IP, for example.

The various possible architectures are shown on the following pages.

Automation of a Production Line

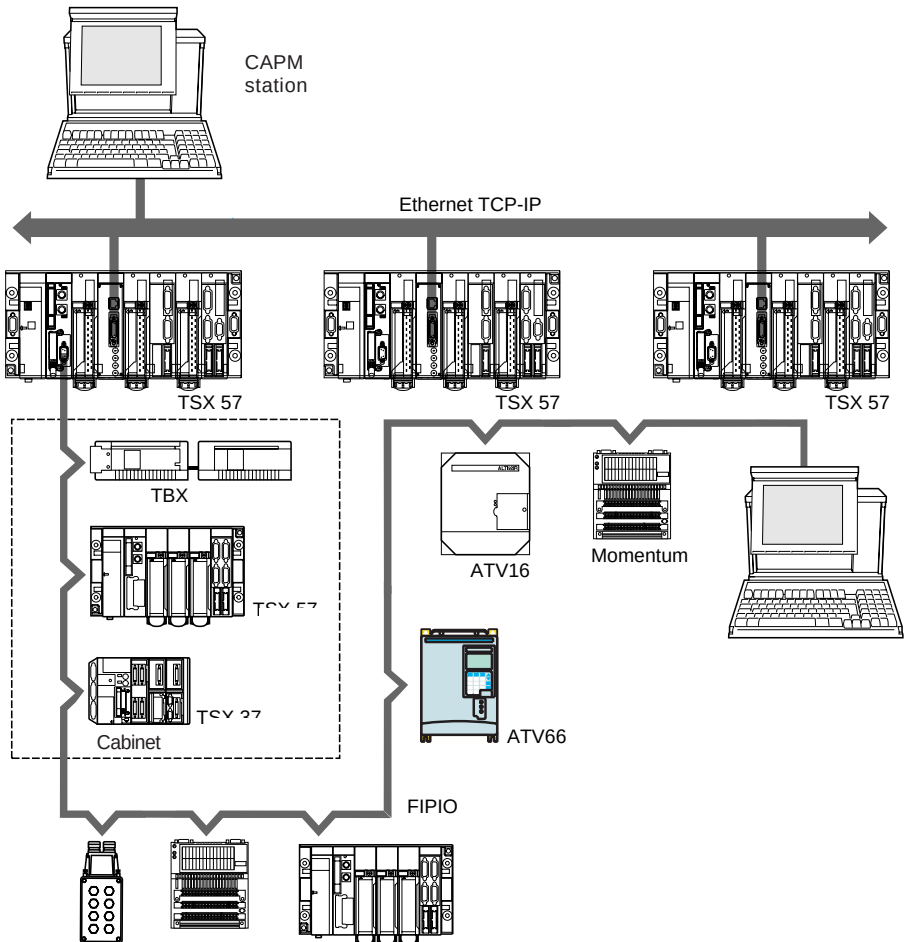


Remotely locating the I/O means that the control system components no longer have to be installed in the PLC control cabinet, but can be located near the operating equipment on the factory floor.

The decentralization of industrial operations favors the manufacture of modular machines or ones which can be easily dismantled. This means that the best use can be made of the preprocessing and diagnostics functions offered by intelligent sensors and preactuators. Control and diagnostics systems can more easily be set up in the heart of the installation, where they are really useful.

1.2-2 Multistation Architecture

Production Factory



In this type of hierarchical architecture, the FIPIO fieldbus is governed by the plant-wide ETHWAY network.

The transparency provided by this type of architecture carries production and distribution data to the Computer-Aided Production Management System (CAPM).

The programming terminal, connected to priority address 63 on the FIPIO bus, can access the complete architecture without having to be configured.

2.1 General

A device on the FIPIO fieldbus is identified by its connection point.

The connection point number is the physical address of the device on the bus and takes a value from 0 to 127.

Address 0 is reserved exclusively for the bus manager PLC.

Address 63 is allocated to the programming terminal. This dedicated address allows this terminal to access the complete network architecture without having to be configured first.

All the other addresses can be used by devices that can be connected to FIPIO, but they must first be configured with programming software.

Bus arbitrator

On a FIPIO bus, a single manager PLC authorizes data exchange; this is the active bus arbitrator which controls access to the medium.

The function of the bus arbitrator is to scroll the list of messages to be sent and then decide when the aperiodic exchanges of variables and messages requested will take place.

The list of cyclic exchanges and the windows assigned for aperiodic traffic form a macro-cycle. The continuous scanning of this macro-cycle is performed by the active bus arbitrator.

On a FIPIO bus, the macro-cycle is linked to the data exchange requirements of the application program. This cycle will :

- Scan the status variables and the device command variables, taking into account the need to update the PLC tasks,
- Assign a window for aperiodic exchange of variables for configuration, control and diagnostics of remote devices,
- Assign a window for aperiodic exchanges of messages which will be shared among all the devices using the message handling service (this window allows exchanges of twenty 128-byte messages per second; this data rate is 50 messages per second for 32-byte messages).

All these functions are supported automatically by the system when the bus is configured.

2.2 Characteristics

Structure

Type	: WORLD FIP-standard open industrial fieldbus.
Topology	: Devices connected in extension or drop mode.
Access method	: Controlled by the bus arbitrator.
Communication	: Communication is by the exchange of variables which the user can access in the form of PLC objects and X-WAY datagrams.
Priority exchanges	: Cyclic exchanges of status variables and remote I/O commands (parameter variables and X-WAY datagrams are also exchanged).

Transmission

Mode	: Base band physical layer on shielded twisted pair (standard IEC1158-2).
Binary data rate	: 1 Mb/s.
Medium	: Shielded twisted pair (impedance 150 Ohms).

Configuration

No. of connection points	: 128 logical connection points for the whole architecture.
No. of segments	: A maximum of 44 between 2 stations. Depends on the distance between them (see below).
PLC	: One PLC at address 0.
Terminal	: One programming terminal connected on connection point 63.
Segment length	: A maximum of 1000 meters per electrical segment. A maximum of 2500 or 3000 meters per optical segment (depending on the type of fiber) (see section 3.4, part D).
Multistation	: Network transparency is ensured with FIPWAY or Ethernet TCP-IP.

Maximum length of a FIPIO bus

The maximum length in km of cable (electrical or fiber optic) between the 2 stations furthest apart (including the bus arbitrator station) is $22 - (0.5 \times R)$: where R is the number of repeaters (electrical or fiber optic) crossed by the FIP data between these 2 stations.

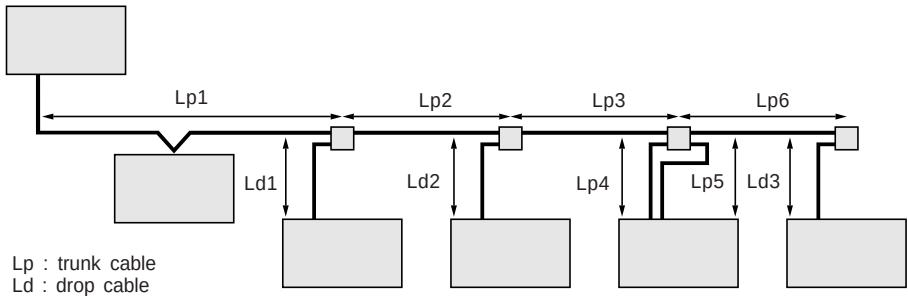
Note :

This rule only concerns architectures based on Premium bus arbitrator stations (TSX 57xx2, TPMX 57xx2 or TPCX 57xx2) and TSX FP ACC6 electrical and TSX FP ACC8 fiber optic repeaters.

Configuration (continued)

Drops : These connections are made through the use of taps, drop cables or loop-back of the trunk cable. If a drop cable is used, the length of the drop is equal to three equivalent trunk cable lengths. The length of a segment is therefore equal to :

$$L = \text{sum of the } L_{px} + 3 \times \text{sum of the } L_{dx} \leq 1000 \text{ m}$$

**Services**

- Remote I/O** : Exchanges of I/O channel status variables and output channel commands in cyclic mode without any intervention from the application program.
Remote device management (configuration etc.) in aperiodic mode without any intervention from the application program.
- UNI-TE** : Point-to-point request service with confirm, maximum of 128 bytes. This service can be used by all the stations connected to FIPIO that support this service.
- Data integrity** : Control characters on each frame and acknowledgment of point-to-point messages
- Supervision** : The PLCs and their inputs / outputs (local or remote) are diagnosed by one of the following terminals : FTX 517, CCX 7, FTX 417 or PC compatible.

Maximum size of the data sent

Variables : 128 bytes.

Messages : 128 bytes.

Message data rate: twenty 128-byte messages per second by default.

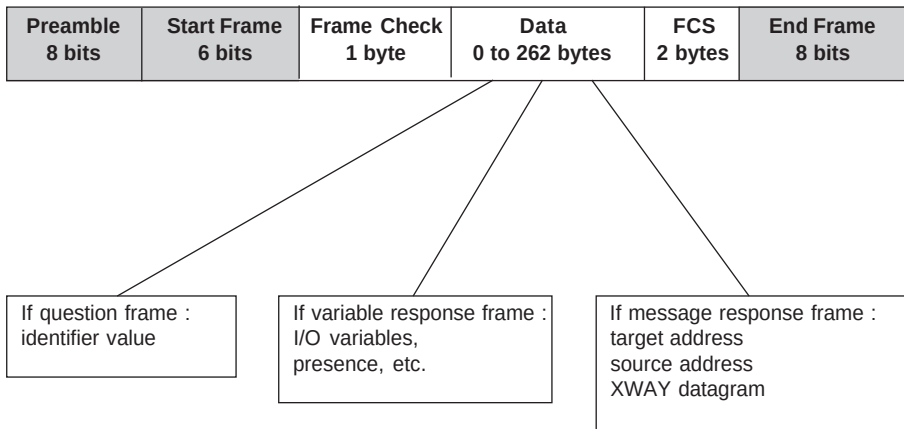
2.3 FIPIO Exchange Format

The following information is not absolutely necessary when using a FIPIO bus. It is provided for familiar users as a brief explanation of how the network operates.

A data exchange on the FIPIO bus constitutes the transfer of two frames :

- A question frame containing the identifier of the variable to send or the source entity of a message to send,
- A response frame containing the value of the identified variable or the application message sent on the bus.

The FIPIO frame is broken down as follows :



Preamble :

This 8-bit string allows the receivers to synchronize to the clock of the source station.

Start frame delimiter :

This start frame delimiter comprises eight bits and allows the data link layer to locate the start of its assigned data.

Frame check :

This byte tells you what type of frame has been exchanged :

- Question frame : identified variable, message or request,
- Response frame : identified variable, message acknowledged or not acknowledged, acknowledgment or request etc.

Data :

This field contains :

- The identifier value (two bytes) for a question frame,
- The value of the application variable (2 to 128 bytes) for an identified variable response frame,
- A source address (three bytes), a target address (three bytes) and an XWAY datagram (128 bytes of useful data) for a message response frame being sent to XWAY address,
- a string of identifiers for a request response frame (system service).

FCS (frame check sequence) :

These two bytes are used to check that the data exchange is performed correctly. The check code is calculated by the source station and then sent after the data. The receiving station recalculates the code and compares it with that received from the source. If the two do not match, the frame is refused by the target station.

End frame delimiter :

The end frame delimiter comprises eight bits and allows the data link layer to locate the end of its assigned data.

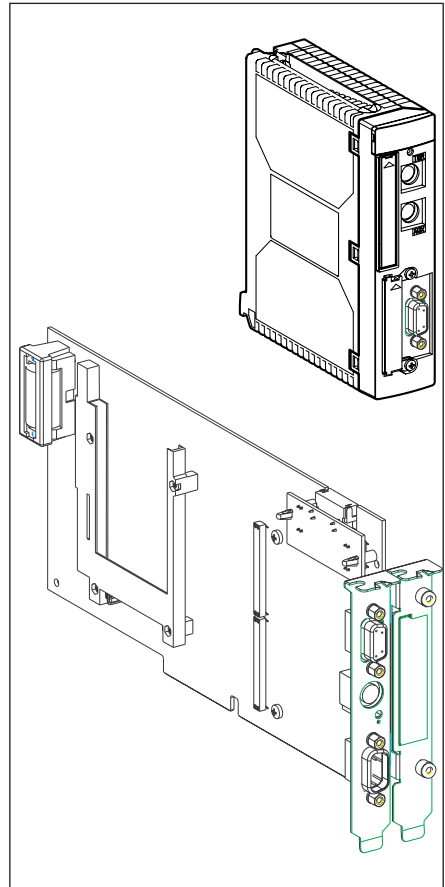
3.1 Processors

3.1-1 TSX, PCX and PMX Processors

TSX P 57252/ 57352 / 57452, TPCX 573512 and TPMX P57352 / 57452 PLC processors are all equipped with a FIP link.

This link only operates in FIPIO mode.

The PLC processor is connected to the FIPIO bus by the TSX FP ACC12 connector.



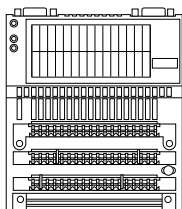
3.2 TBX Remote I/O

Schneider Automation offers a number of different types of remote I/O interface :

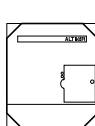
- Momentum : discrete or analog,
- TBX : discrete and analog, monobloc, modular, or dust and damp proof,
- TSX 37 or 57 acting as FIPIO agent,
- CCX 17 operator panels,
- ATV16 / 58 / 66 speed drives,
- TBX SAP 10 gateway acting as an interface between the FIPIO bus and the AS-i bus,
- partner products under the FIP-connect banner

These remote I/O will :

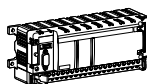
- Reduce the amount of wiring needed for the sensors and actuators,
- Do away with the mechanical stress inherent in cableways,
- Reduce connection design and test time,
- Provide more machine or installation availability,
- Provide open-ended installations that can be tailored to requirements through the number and type of modules used,
- Allow a more rational operation of the PLCs,



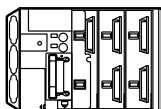
Momentum



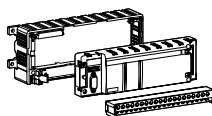
ATV
16 / 58 / 66



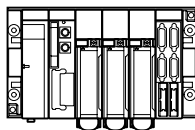
monobloc TBX



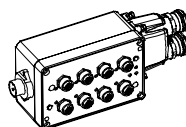
TSX 37 Agent



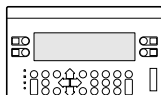
modular TBX



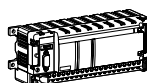
TSX 57 Agent



dust and damp proof TBX



CCX 17



TBX SAP 10
AS-i gateway

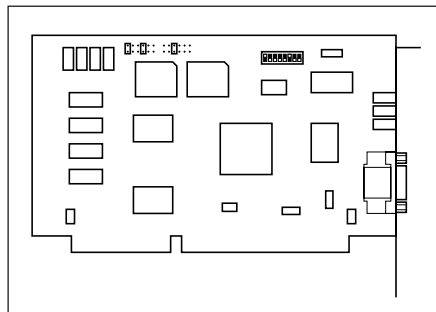
3.3 TSX FPC 10 Module

This module is used to connect the following to the FIPIO bus :

- FTX 507 or FTX 517 programming terminals,
- CCX 57/77 supervision systems,
- Any machine equipped with a PC AT bus running on DOS (version • 3.1) or Windows.

The TSX FP CE 030 cable and the TSX FP ACC4 or TBX FP ACC10 tap are used to connect the above devices to the FIPIO bus.

This module is a half-size PC extension board. It slides into one of the slots on the bus.



A FIP DOS driver, a Windows driver and an Installation Manual are provided with this module.

The programming terminal that contains the TSX FPC 10 interface module must be connected to address 63 of the FIPIO bus to be able to access the complete architecture without having to be configured first.

Reminder : data cannot be downloaded from a TSX Premium manager PLC via the FIPIO bus.

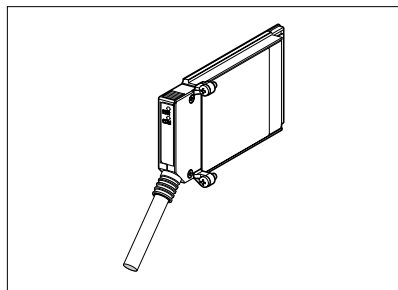
For more information on this module refer to the TSX FPC 10/20 User's Manual.

3.4 Type III PCMCIA Cards

Type III PCMCIA cards are used as standard for connecting various devices to the FIPIO bus :

- TSX FPP 10 FIPIO agent PCMCIA card,
- TSX FPP 20 FIPWAY PCMCIA card.

These cards are connected to the TSX FP ACC4 or TBX FP ACC10 tap via a 1m or 3m cable : TSX FP CG 010 / 030.



3.4-1 Module for FTX 417-40 Notebook or PC-compatible

The TSX FPP K 200M module for type III PCMCIA slots consists of :

- 1 TSX FPP 20 FIPWAY PCMCIA card ,

A TSX FP CG010/030 connection cable (1 or 3 m) is required to connect it to the TSX FP ACC4 or TBX FP ACC10 tap.

3.4-2 Module for CCX 17 Operator Panel

The TSX FPP 10 card with a TSX FP CG010/030 cable are used to connect the CCX 17 panel to the TSX FP ACC4 or TBX FP ACC10 tap.

3.4-3 Module for FIPIO Standard Device Profile

The FCP FPC 10 module is used to connect a FIPIO agent device equipped with an ISA bus (PC type).

The FCP FPC 10 card with a TSX FP CE 030 cable is used for connection to the TSX FP ACC4 or TBX FP ACC10 tap.

3.4-4 Connection Kit for the ATV 16 Speed Drive

The TSX FPP 16 • • module is used to connect ATV 16 speed drives for asynchronous motors equipped with the VW3-A16 303 communication module. Connection to the FIPIO bus is via :

- a TSX FPP 10 FIPIO agent PCMCIA card,
- a TSX FP CG 010 connection cable,
- a TSX ACC4 tap.

3.4-5 Connection Kit for the ATV 58 Speed Drive

Connection to the FIPIO bus is via the VW3-A58301 communication card installed in the drive. This card is equipped with a male 9-pin Sub-D connector which can take a TSX ACC2 or TSX ACC12 connector for extension or drop connection to the FIPIO bus.

3.4-6 Connection Kit for the ATV 66 Speed Drive

Connection to the FIPIO bus is via :

- the VW3-A66205 communication card installed in the drive which takes the VW-A66301 PCMCIA card,
- a VW-A66331 connection kit comprising a cable 3m long with two 9-pin Sub-D sockets and a 9-pin to 25-pin Sub-D adaptor to enable connection to a TSX FP ACC4 tap.

4.1 Remote I/O service

The FIPIO fieldbus supports the remote I/O service. This is the FIPIO priority service.

This service is used to exchange input status variables and output commands. Such exchanges are performed cyclically and automatically without any intervention from the application program.

Remote devices can be managed via this service (configuration etc). These exchanges are performed aperiodically without any intervention from the application program.

In order to use this service, the remote I/O must be configured with PL7 software from the PLC (online).

The diagnostics and maintenance functions are accessible via the PL7 debugging and adjustment screens.

4.2 UNI-TE Service

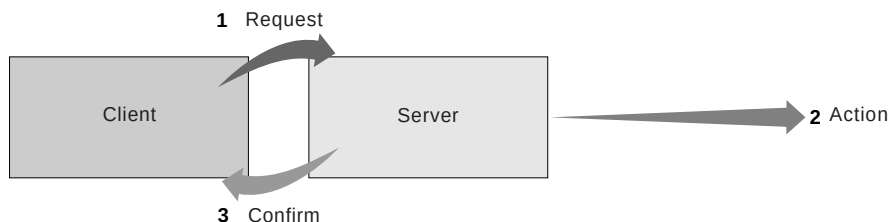
The FIPIO bus supports UNI-TE industrial message handling system protocol. UNI-TE enables point-to-point communication using a question and answer dialog called Request/Confirm.

Dialog sequencing

A device that supports the UNI-TE protocol can be a :

- CLIENT** : This device initiates communication. It asks a question (reads), sends a command (writes) or an instruction (Run, Stop etc.).
- SERVER** : This device executes the instruction sent by the client and sends a confirm after execution.

The services supported depend on the type of device, eg. PLC, programming terminal, supervision system. Depending on its function, each device can be a Client and/or a Server. A programming terminal is generally a Client on FIPIO and communicates with the server of the bus manager PLC.



UNI-TE is especially suited to applications such as supervision, diagnostics and control. The maximum length of the messages is 128 characters.

Exchange integrity

The UNI-TE service uses a FIP message system data link layer transmission and acknowledgment exchange.

5.1 Initial Start-Up of the Application

This procedure applies to a FIPIO fieldbus which has been wired using the procedure which ensures bus matching and continuity. It is used to detect any duplicate addresses.

- 1 Switch off the PLC and all the FIPIO devices,
- 2 Configure the processor at address 0 with an application which uses I / O on FIPIO,
- 3 Code the address on the first device, connect it to the bus and then power it up,
- 4 Normally there are four LEDs available for bus diagnostics : RUN, ERR or DEF, I / O and COM. If all LEDs are flashing simultaneously, switch off the device and check the address code, as a device with this address is already connected to this bus.
- 5 Repeat points 3 and 4 for each device which is to be connected. Leave the devices that have already been connected continuously powered up.

5.2 Adding a Device to an Existing Application

- 1 Code the address or the terminal block on the first device to be connected and then power it up and connect it to the bus,
- 2 Check that the DEF or ERR LED goes out. If the RUN, ERR , I/O and COM LEDs flash simultaneously after two seconds, then switch off the device and check the address coding because a device with this address is already connected to the bus.

Important

Devices often need to be powered up after the address has been coded, since the new address is only taken into account after a restart. See the documentation for the connected device.

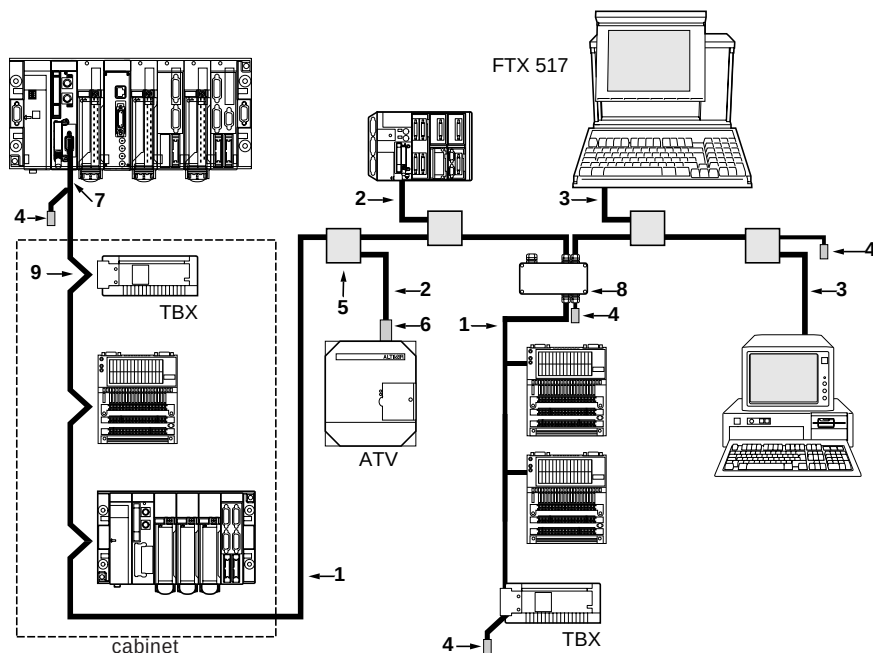
Section	Page
1 Connection Accessories	1/1
1.1 FIPIO Bus Connection Accessories (IP20)	1/1
1.2 Description of the Different Accessories	1/2
1.3 FIPIO Bus Connection Accessories (IP65)	1/8
1.4 Description of the Different Accessories (IP65)	1/9
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3.5-4 Connecting the TSX FP ACC14 taps	3/14
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4.2 Testing Bus Continuity	4/2
4.3 Testing for Line Terminators	4/4

1.1 FIPIO Bus Connection Accessories (IP20)

Schneider Automation offers a range of accessories for connecting the various IP20 devices to the FIPIO bus. These are the same as those used for FIPWAY. Only the TBX BLP 01 connector is a FIPIO dedicated connector.

C



- 1 TSX FP CA/CRxxx : Trunk cable
- 2 TSX FP CCxxx : Drop cable,
- 3 TSX FP CE030 : Connecting cable for terminals and PC,
- 4 TSX FP ACC7 : Line terminator,
- 5 TSX FP ACC4 : Tap,
or TSX FP ACC14
- 6 TSX FP ACC2 : Connector for extension or drop connection,
- 7 TSX FP ACC12 : Connector for TSX PLC,
- 8 TSX FP ACC6 : Electrical repeater, or TSX FP ACC8
fiber optic repeater for a fiber optic link,
- 9 TBX BLP 01 : Connector for TBXs
TSX FP ACC9 : Tool for testing the wiring system (not shown).

1.2 Description of the Different Accessories

1a TSX FP CA xxx trunk cable

This 8 mm diameter 150 Ohm flexible cable comprises a shielded single twisted pair. It is available in 100, 200 or 500 meter reels, with outer insulation made of black PVC. It is used to connect the various devices to the FIPWAY/FIPIO network either directly or by using TSX FP ACC4 taps. The D+ wire insulation is red and the D- insulation is green. The characteristics of the trunk cable are provided in the Appendix, part E.

1b TSX FP CR xxx trunk cable for harsh environments

This 8.6 mm diameter 150 Ohm flexible cable comprises a shielded single twisted pair. It is available in 100, 200 or 500 meter reels. It is used to connect the various devices to the FIPWAY/FIPIO network either directly or using TSX FP ACC4 or TSX FP ACC14 tap. Its characteristics enable it to be used in mobile installations or subject to particular environmental constraints (out of doors, chemical corrosion, etc). The D+ wire insulation is orange and the D- insulation is black.

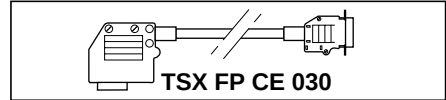
2 TSX FP CC xxx drop cable

This 8 mm diameter 150 Ohm flexible cable comprises two shielded twisted pairs. It is available in 100, 200 or 500 meter reels with outer insulation made of black PVC. It is used for drop connections made from a TSX FP ACC4 or TSX FP ACC14 tap. The equivalent trunk cable length to take into account for network calculations is three times the physical length of the drop cable. The "electrical" length of a drop connection is three times its physical length. The insulation of the D+ wires is red and orange and that of the D- wires is green and black. The characteristics of the drop cable are provided in the Appendix, part E.

3 TSX FP CE 030 connection cable

This cable consists of a 3-meter long shielded multiple pair cable with a connector fitted to each end : a 15-pin connector for connection to the terminal and a 9-pin connector for connection to the network. It is used to connect FTX 507, FTX 417, CCX 7 and PC-compatible terminals to the FIPWAY/FIPIO network. The terminal must be fitted with a TSX FPC 10 network interface module (for FTX 507, CCX 7 or PCs equipped with an ISA bus) or a TSX FPC 20 module (for FTX 417).

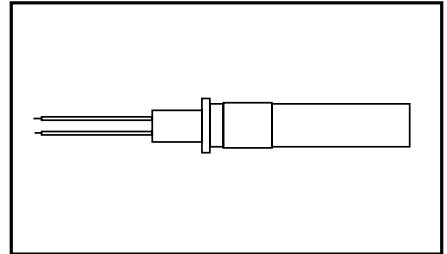
A TSX FP ACC4 or TBX FP ACC10 tap must be used for connection to the bus.



4 TSX FP ACC7 line terminator

This line terminator is used for matching FIPWAY/FIPIO segments.

A line terminator must be placed at both ends of each bus segment. It is unpolarized and can be connected to all connection accessories in place of the second segment of the trunk cable.

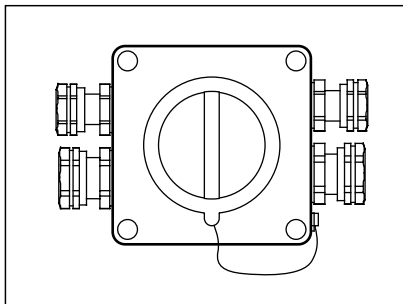


5a TSX FP ACC4 tap

This tap with **IP 65 protection** is used for drop connection of devices to the FIPWAY/ FIPIO network.

It too is equipped with a 9-pin female connector and, via the TSX FP CE 030 or KIT5130 cables (excluding cables fitted with male 9-pin connectors), will connect :

- a terminal equipped with a TSX FPC 10/20 or a TSX FPP 10/20 PCMCIA card
- an APRIL 5000 PLC.



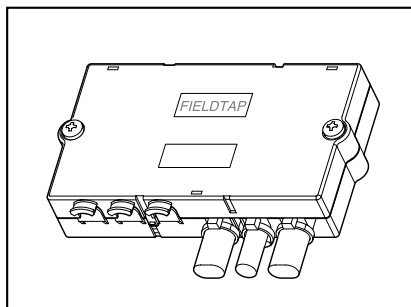
Network operation is not affected by the connection or disconnection of the terminal. The various cables are connected by screw terminal blocks (one terminal block for each twisted pair). The tap provides protection to IP65 standard and allows cables to be fed through cable glands of the same standard. The connection socket on the terminal can be accessed once the quarter-turn protective cap has been removed. The protection index then drops to IP 21.

The TSX FP ACC4 tap can be fitted with a TSX FP ACC7 line terminator.

5b TSX FP ACC14 tap

This **unsealed** tap can be used for low-cost drop connection of any device on the bus.

It can be fitted with the TSX FP ACC7 line terminator.

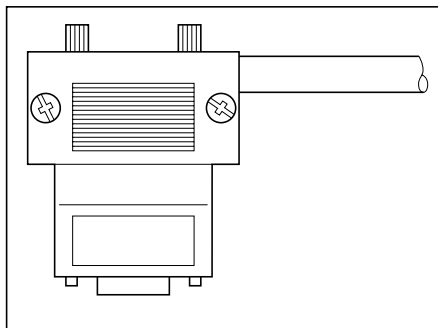


6 TSX FP ACC2 connector

This connector is used to connect ATV 58 or Momentum PLCs to the FIPIO bus by means of extension or drop cables.

A screw terminal is used to connect the various cables. Full connection compatibility is ensured with TSX FP CA/CRxxx and TSX FP CCxxx cables.

TSX FP ACC2



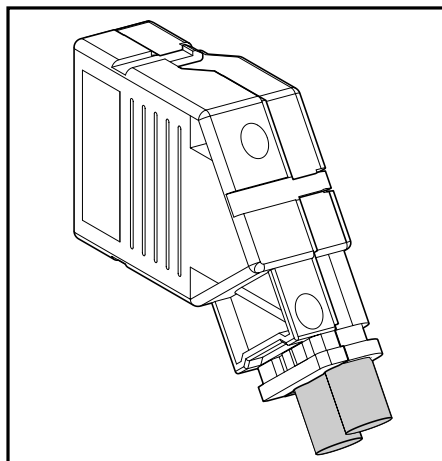
7 TSX FP ACC12 connector

This connector is used to connect TSX Premium manager PLCs (TSX 5725/35, TSX 5745, PCX 5735/45 and PMX 5735/45) to the FIPIO bus by means of extension or drop cables.

A screw terminal is used to connect the various cables. Full connection compatibility is ensured with TSX FP CA/CRxxx and TSX FP CCxxx cables.

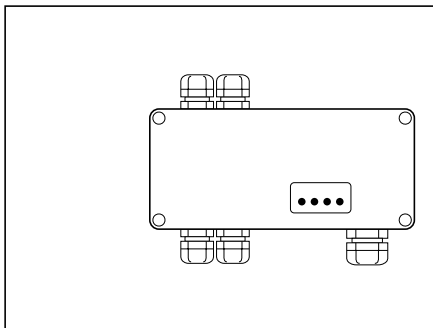
This connector can also be fitted with a TSX FP ACC7 line terminator.

TSX FP ACC12



8a TSX FP ACC6 electrical repeater

This dust and damp proof module is used to connect two electrical FIPIO segments. The length of the network can be increased, linear or tree-type topologies can be created and the maximum number of devices connected to the network is also increased (a maximum of 127 logical connections on the complete network). By using several repeaters, the maximum network length can be extended to 15000 meters.

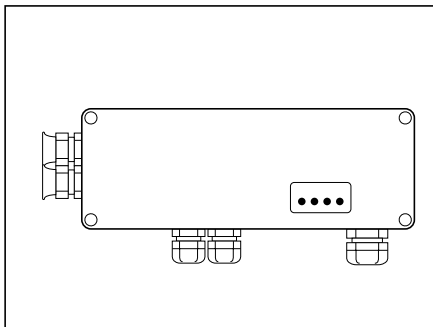


Screw terminals are used to connect the various cables. This module uses 24 VDC (150 mA) or 48 VDC (75 mA) which is connected to a special terminal block. Four LEDs indicate that this terminal block is operating correctly. The TSX FP ACC6 repeater provides protection to IP65 standard and allows cables to be fed through cable glands of the same standard. It can be fitted with one or two TSX FP ACC7 line terminators.

8b TSX FP ACC8 fiber optic / electrical repeater

This dust and damp proof module is used to connect electrical cells (FIPIO segments whose ground cannot be made equipotential), and which are further than 1000 m / 3000 m maximum apart and/or separated by areas with high levels of interference.

By using fiber optic / electrical repeaters, as with electrical repeaters, the number of devices on FIPWAY/FIPIO can be increased (127 logical connections max.) as well as the length (15000 m max.).



The fiber optic / electrical repeater uses a 24 VDC or 48 VDC supply. Four LEDs indicate that this terminal block is operating correctly.

A 2 m long fiber optic cable (fiber optic jumper) TSX FP JF 020 enables :

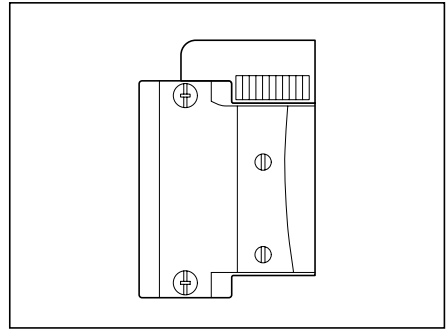
- the TSX FP ACC8 to be used as an interface between a FIP fiber optic station and a FIPWAY/FIPIO segment,
- the TSX FP ACC8 to be connected to an fiber optic cable patch panel.

Characteristics and performance : see Appendix 4, part E.

9 TBX BLP 01 connector

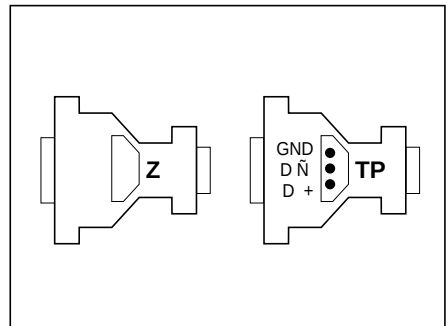
This connector is used to connect TBX distributed I/O interfaces to the FIPIO bus using an extension or drop cable. Full connection compatibility is ensured with TSX FP CA/CRxxx and TSX FP CCxxx cables.

The TBX BLP 01 connector can be fitted with a TSX FP ACC7 line terminator.



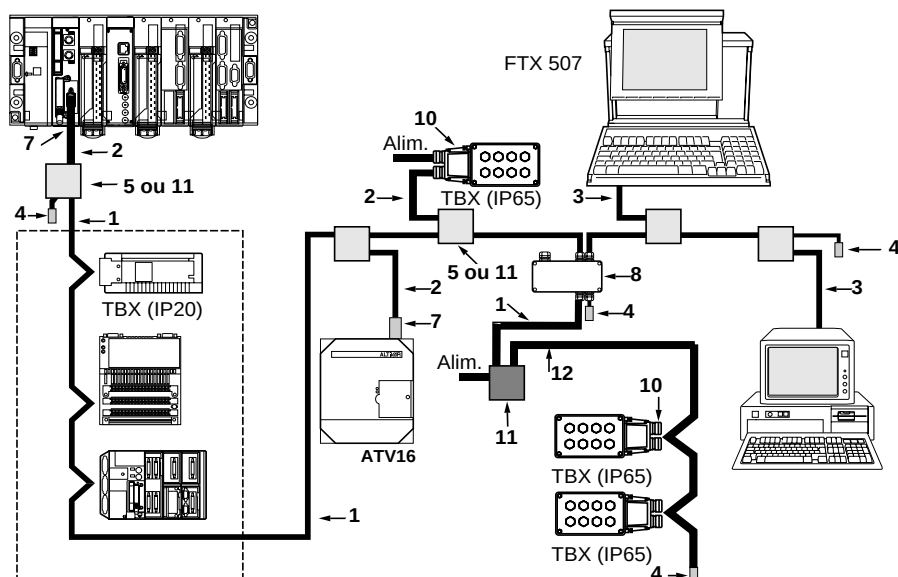
FIP TSX FP ACC9 wiring test tool

This tool is used to test each segment in the network (network continuity, line terminators fitted, etc). It comprises two modules, Z and TP.



1.3 FIPIO Bus Connection Accessories (IP65)

Schneider offers a range of dust and damp proof accessories for connecting the various IP65 devices to the FIPIO bus.



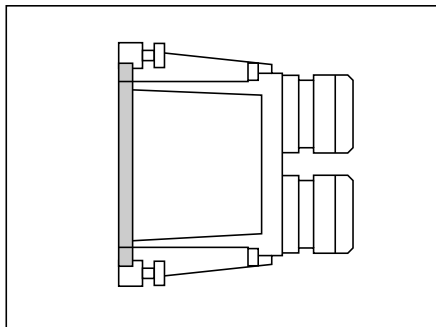
- | | | |
|----|--------------------------------|--|
| 1 | TSX FP CA/CRxxx | : Trunk cable, |
| 2 | TSX FP CCxxx | : Drop cable, |
| 3 | TSX FP CE030 | : Connecting cable for terminals and PC, |
| 4 | TSX FP ACC7 | : Terminator, |
| 5 | TSX FP ACC4
or TSX FP ACC14 | : Tap, |
| 6 | TSX FP ACC2 | : Extension or drop cable connector, |
| 7 | TSX FP ACC12 | : Connector for TSX PLCs, |
| 8 | TSX FP ACC6 | : Electrical repeater or TSX FP ACC8
fiber optic repeater for a fiber optic link, |
| 10 | TBX BLP 10 | : TBX connector (IP65), |
| 11 | TBX FP ACC10 | : Tap, |
| 12 | TSX FP CFxxx | : Remote power cable, |
| | TSX FP ACC9 | : Tool for testing the wiring system. |

1.4 Description of the Different Accessories (IP65)

10 TBX BLP 10 (IP65) connector

This connector is used to connect TBX distributed I/O interfaces to the FIPIO bus by using an extension or drop cable. Full connection compatibility is ensured with TSX FP CFxxx and TSX FP CCxxx cables.

The TBX BLP 10 connector can be fitted with a TSX FP ACC7 line terminator.



Note :

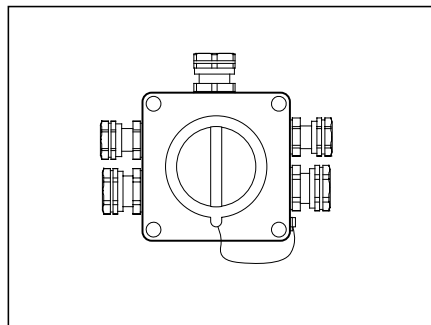
All connection accessories for TBX (IP20) interfaces can be used to connect TBX (IP65) interfaces, with the exception of the TBX BLP 01 (see section 1.2, part C).

11 TBX FP ACC10 tap

This dust and damp proof tap has the same functions as the TSX FP ACC4 tap.

It also enables the 24 VDC module power supply to be connected.

The supply is carried via the remote power cable TBX FP CFxxx.



12 TSX FP CF xxx remote power trunk cable

The TSX FP CF xxx trunk cable is a flexible cable approximately 9.5 mm in diameter, consisting of a shielded twisted pair with 150 Ω characteristic impedance and a power supply pair. It is available in 100, 200 or 300 m reels, and is used to connect dust and damp proof TBXs (IP 65) to the FIPIO bus. Its characteristics make it suitable for use in mobile installations or those subject to particular environmental constraints (outdoors, chemical attack, etc). For the shielded twisted pair, the insulation of the D+ wire is orange, and that of the D- wire is black. For the power supply pair, the insulation of the + wire is pink, and that of the - wire is blue.

2.1 Principles

Since a network can evolve (increased length of the trunk cable, connection of additional devices or taps), precise bus calculations and a complete bus design file will be invaluable when planning any future changes to the network. This file will also be useful when performing maintenance.

C

Three rules must be observed when designing the wiring for a FIPIO bus :

- Determine the number of electrical segments comprising the bus,
- Check that the right number of devices are connected to the network,
- Determine the number of line terminators.

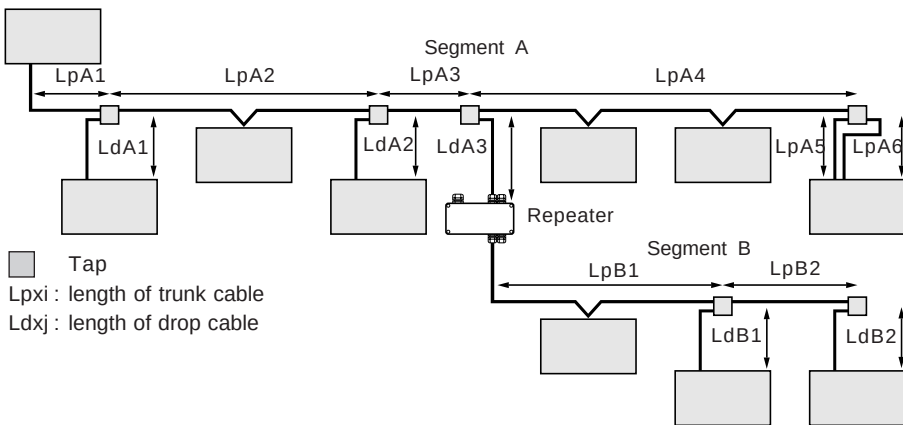
2.1-1 Determining the Number of Electrical Segments

When designing a FIPIO bus, the following rule must be observed :

The maximum length of an electrical segment including the taps is 1000 meters of equivalent "trunk cable".

The network designer must take into account the type of connections used (extension or drop connections using drop cable or trunk cable etc.) The drop connections carried out using TSX FP CE030 and TSX FP CG010 / 030 cables (for connecting programming terminals, etc) should not be counted when calculating the length of FIPIO segments.

- When TSX FP CCxxx drop cables are used (drop cable with two twisted pairs) the length of trunk cable equivalent to the drops is three times the physical length of the drop connections. For example, if the sum total of the drop connections is 150 meters, the maximum length of trunk cable will be 550 meters ($550 = 1000 - 3 \times 150$).
- When TSX FP CA/CRxxx trunk cables are used (single twisted pair), the device on the drop connection must be connected to the TSX FP ACC4 or TBX FP ACC10 connection box by two cables, one for each direction. The length of trunk cable equivalent to the drop connections is therefore twice the length of these drops. If, for example, the sum total of the drop connections is 150 meters, the maximum length of trunk cable will be 700 meters ($700 = 1000 - 2 \times 150$).

Example :

The length of segment A, shown by the relation below, must always be shorter than 1000 meters :

$$L \text{ segment A} = \sum LpAi + 3\sum LdAj$$

The length of segment B, shown by the relation below, must always be shorter than 1000 meters :

$$L \text{ segment B} = \sum LpBi + 3\sum LdBj$$

If the length of a cable is calculated to be longer than 1000 meters, an additional segment must be created and connected via an electrical repeater.

2.1-2 Maximum Number of Devices

Rules :

A maximum of 36 devices can be connected on the same segment, a device being either a station or a repeater.

The TSX FP ACC4 and TBX FP ACC10 taps are not considered as devices.

A programming terminal or a supervision system connected via a TSX FP CE 030 cable to a TSX FP ACC4 or TBX FP ACC10 tap is counted as one device.

If more than 36 devices are to be connected, one or more additional segments must be created so that the above-mentioned rule is adhered to.

2.1-3 Line Terminators

For matching purposes an electrical segment must be fitted with a TSX FP ACC7 line terminator at both ends.

Line terminators are sold in multiples of two. One pair is required for each electrical segment.

Each line terminator can be connected to any wiring element :

TSX FP ACC 12, TSX FP ACC14, TSX FP ACC2/ACC4/ACC6, TBX FP ACC10, TBX BLP 01/10.

A description of each of these elements is given in the section on fitting TSX FP ACC7 line terminators.

3.1 Installing the Cables

The following table gives the cable references and shows which cables should be used for which environmental conditions.

C

3.1-1 Cable Usage Criteria

The table below shows standard and severe operating conditions.

Application	Inside building		Outside building	
Operating conditions	Trunk cable	Drop cable	Trunk cable	Drop cable
Standard, without special precautions fixed installation	TSX FP CAxxx	TSX FP CCxxx	TSX FP CRxxx	TSX FP CRxxx
Resistance to hydrocarbons, industrial oils, detergents	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Resistance to solder splashes	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Up to 100% humidity with significant variations in temperature -10°C < θ°C < 70°C	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Mobile installations	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx	TSX FP CRxxx
Other special conditions	Ask your Regional Sales Office			

See section A 2 for connections using TSX FPCCxxx and TSX FPCRxxx cables.

3.1-2 Exception for Dust and Damp proof TBXs

A remote power cable (TSX FP CF xxx) must be used for extension connection of dust and damp proof TBXs.

A TSX FP CCxxx cable is used for drop connections to a TBX and the power supply is transmitted to the TBX via a separate cable.

For more details see part A, section 2 and part C, section 3.5-5.

Important : If the cables are stored in coils and not on drums, unravel the cable from the outer edge of the coil, in order to avoid subjecting the cable to severe mechanical stress.

3.1-3 Installation rules

Certain precautions must be taken when installing FIPIO in order to ensure stable operation of the installation.

See the sections in this manual which describe the hardware to be used when constructing a FIPIO bus. Precautions during setup are detailed in the wiring guide "electromagnetic compatibility of industrial networks and fieldbuses".

3.2 Installing Connection Accessories

3.2-1 Fixing

Installing the TSX FP ACC4, TSX FP ACC14 or TBX FP ACC10 tap

This tap can be fixed to an AM1 PA... perforated mounting plate or to an AM1 DE/DP symmetrical DIN rail with an LA9 D09976 fixing plate. For the TSX FP ACC14, the cable shielding is connected to the connection box by tightening the clamp holder. Connect the tap machine ground securely with a green/yellow wire.

Installing the TSX FP ACC6 or TSX FP ACC8 repeater

The repeater can be fixed to an AM1 PA... perforated mounting plate or to an AM1 DE/DP symmetrical DIN rail with an LA9 D09976 fixing plate.

Installing the TSX FP CE 030 cable on the TSX FP ACC4 or TBX FP ACC10 tap

To connect this cable, remove the quarter-turn cap on the top part of the tap to access the connector. Make sure that the cable is secured by tightening the two knurled screws.

C

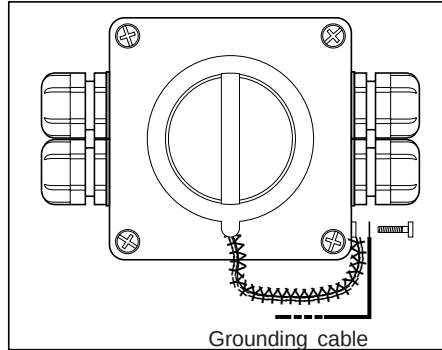
3.2-2 Grounding

C

Each connection accessory is electrically connected to the other ones through the cable shielding. Therefore, the first operation to carry out is to ground the first installation accessory.

Grounding the TSX FP ACC4 and TBX FP ACC10 taps

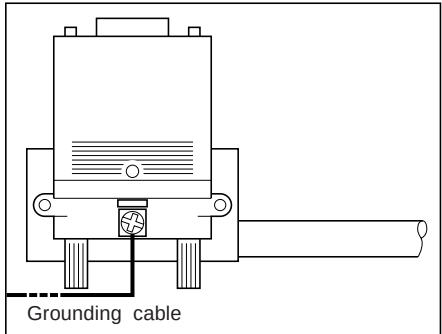
These taps should be secured (using conducting screws and fan-type lock washers) to a conducting metal support that is part of the grounding network. If there is not enough contact (painted support) they can be grounded via the screw located at the bottom right-hand side of the tap. This screw also secures the quarter-turn cap. A short cable with a cross-section of 2.5 mm² or more is required.



Grounding the TSX FP ACC2, TSX FP ACC12, TBX BLP 01 or TBX BLP 10 connectors

Although the connector boxes are different, the grounding principle is the same. The example shown opposite corresponds to the TSX FP ACC2. The grounding screw is on the back of the connectors.

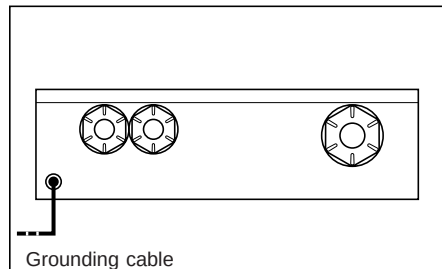
For the TSX FP ACC 12 connector, a grounding wire crimped into the special lug provides the connection to the local ground.



Grounding the TSX FP ACC6 or TSX FP ACC8 repeater

The connection and grounding principle is the same as for the TSX FP ACC4 tap. If the DC power supply cable is equipped with a ground connector and/or shielding, connect this to the terminal with the ⚡ symbol.

The power supply cable shielding is never sufficient to ground the TSX FP ACC6/ACC8 repeater.

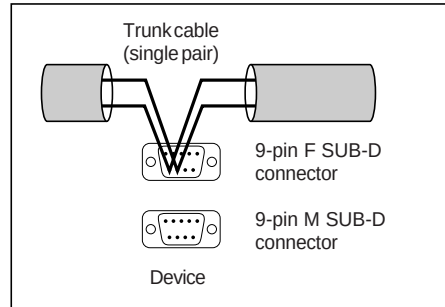


3.3 Wiring the Bus

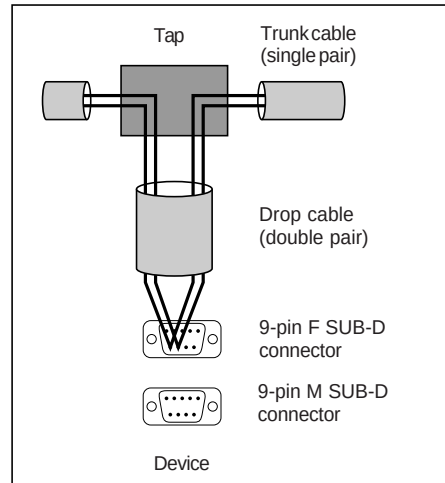
Connection Principles

There are two types of connection for FIPIO devices : extension and drop.

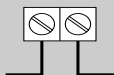
The electrical physical layer of the WORLDIFIP standard does not support "pure electrical drops". All FIPIO devices are connected electrically to the closest shielded twisted pair.



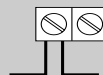
Where an installation requires a tap, this is achieved by looping back the electrical pair, effectively creating a "topological" tap off this cable.



For certain connection accessories, each wire is connected to a special screw terminal, irrespective of the type of connection used (extension or drop).



Right



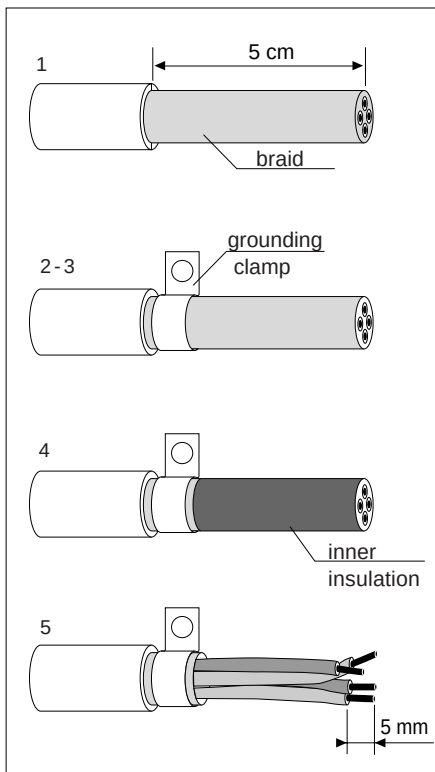
Wrong

3.4 Preparing the Cables

C

Wiring the TSX FP ACC2, TBX BLP 01 connection accessories and the TSX FP ACC4, TBX FP ACC10, TSX FP ACC6, TSX FP ACC8 devices.

- 1 Strip the cable sheath approximately 5 cm,
- 2 Cut the braid near the clamp,
- 3 Mount the grounding clamp (the position of the clamp on the cable must take into account whether it is secured to the connector on the right or left of the cable),
- 4 Cut the inner insulation and the clear rings to expose the wires,
- 5 Strip each of the wires approximately 5 cm and fit the cable ends supplied.



For wiring TSX FP ACC 12 or TSX FP ACC14 accessories, see the quick reference guide supplied with the product.

3.5 Connecting the Different Accessories

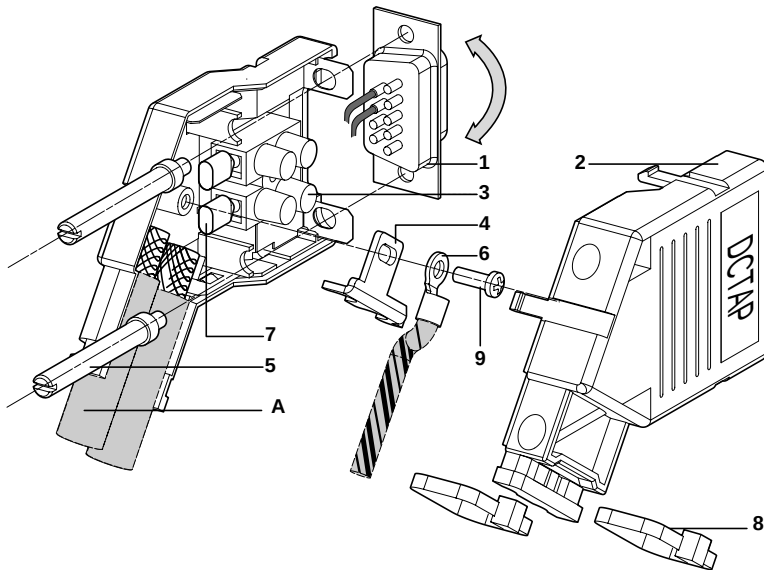
When installing the FIPIO electrical segments, the connection of each wiring system accessory must be checked before connecting the next one. Section 4 describes the test procedure to be performed. Make sure the grounding rules are respected.

C

3.5-1 Connecting Processors using the TSX FP ACC12 Connector

This connector can be used to connect the processors to the FIPIO bus by extension or drop connection.

It is important to ensure continuity of the grounds when wiring the connector.

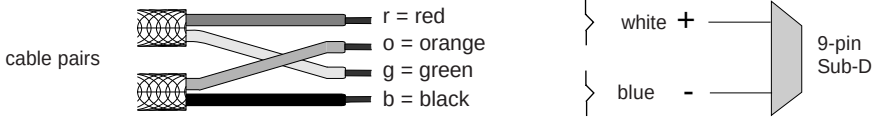


- 1- 9-pin SUB-D connector which can be turned so that the cables exit upwards or downwards
- 2- Cover
- 3- Connection block
- 4- Cable shielding guide bracket
- 5- TSX FP ACC 12 fixing screws
- 6- Ground connection lug
- 7- Double wiring cap
- 8- Cable clamp
- 9- Guide bracket fixing screw

If the connector is located at the end of the bus, cable A is replaced with a standardized TSX FP ACC7 line termination resistor.

For more information, refer to the quick reference guide supplied with each TSX FP ACC12 product.

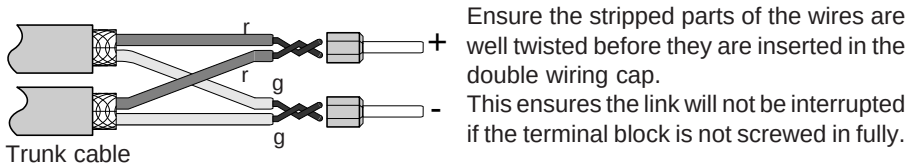
Color coding of signal conductors :



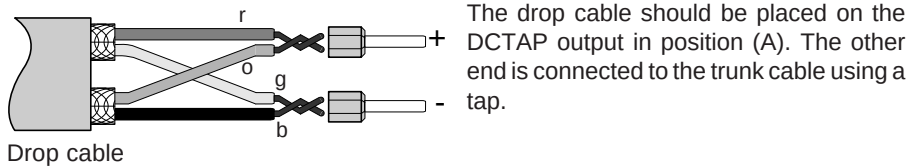
Reminder : The trunk cable contains one shielded pair : red and green wires. The drop cable contains two shielded pairs : red and green wires for one pair and orange and black for the second pair.

Connections :

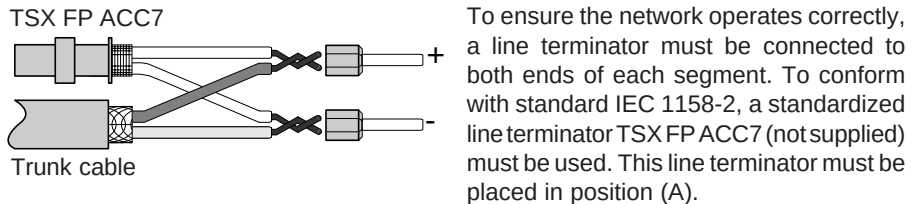
• extension



• drop connection



• line terminator

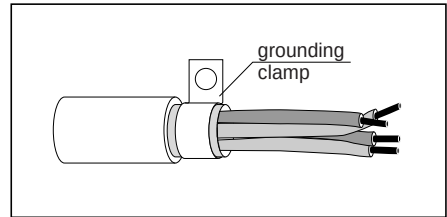


Warning : If the TSX FP ACC12 is not connected to a device, its shielding may carry a dangerous voltage (if the TSX FP ACC 12 is not connected to local ground). This only applies if the machine grounds are not equipotential on all of the bus devices.

3.5-2 Connecting TSX FP ACC2 Connectors

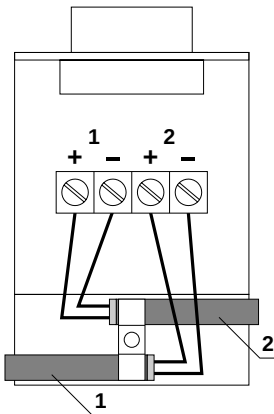
The different cables are connected by means of a screw terminal block. The procedure is as follows :

- 1 Open the connection box,
- 2 Prepare the cables as described on the previous pages and then screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams below show the different types of connection possible : extension or drop connection,
- 3 Secure the grounding clamp(s) in the connector, taking care not to pinch the wires,
- 4 Remove the blanking caps on the cover to expose the cableways,
- 5 Refit the cover and tighten.



Extension connection

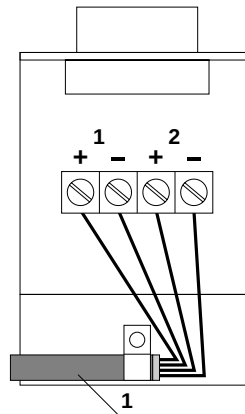
If the device equipped with the connector is placed at the start or the end of a FIPIO segment, only cable 1 is connected to the connection box. In this case, cable 2 must be replaced by an unpolarized TSX FP ACC7 line terminator.



The grounding clamps are fixed in such a way that the incoming cable feeders cannot be placed opposite each other. They must be on the same side (right or left) or one above the other.

Drop connection

In this diagram cable 1 is a TSX FP CCxxx drop cable. If the drop is achieved by 2 TSX FP CA/CRxxx cables, connect in the same way as for extension connection.



In this type of configuration, the cable can arrive either from the right or the left or from the top or bottom.

3.5-3 Connecting the TSX FP ACC4 Taps

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The various cables are connected by means of a screw terminal block. A separate terminal block is used for each twisted pair. The procedure is as follows :

- 1 Open the tap,
- 2 Prepare the cables as explained earlier and feed them through the cable glands,
- 3 Fit a grounding clamp to each cable. The position of the clamp on the cable must take into account how it is secured in the connection box (on the right-hand or left-hand side of the cable),
- 4 Screw each wire into the screw terminal block. Comply with wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-),
- 5 Tighten the grounding clamps and then tighten any cable glands in which a cable or line terminator is located,
- 6 Refit the cover and fasten.

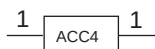
The TSX FP ACC4 tap is also equipped with a 9-pin female connector which can be used to connect :

- a terminal fitted with a card : TSX FPC 10 or FCP FPC 10 and its connection cable TSX FP CE 030,
- a device fitted with a type 3 PCMCIA card : TSX FPP 10, TSX FPP 20, or FCP FPC 10 and its connection cable TSX CG 010 / 030.

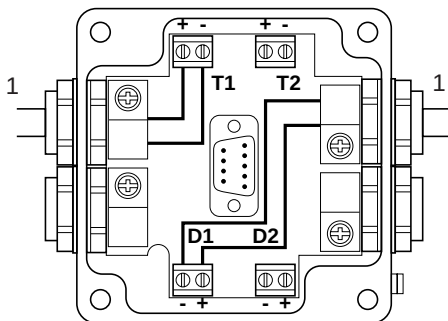
The diagrams on the following pages illustrate the various types of connection possible :

- Tap waiting to be connected,
- Drops connected using a drop cable,
- Connection to a TSX/PMX PLC with line terminator,
- Extensions connected using the trunk cable,
- Connection of a TSX FP ACC7 line terminator.

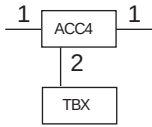
• Tap waiting to be connected



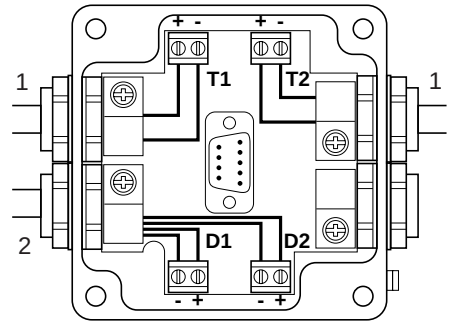
If a tap is waiting to be connected (no TBX wired), the trunk cable (1) TSX FP CA/CR must be connected as shown in the diagram opposite. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



• Drop connected with the TSX FP CCxxx drop cable

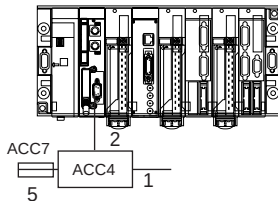


The drop must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



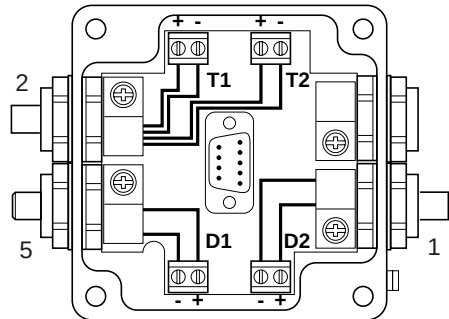
In the example, the drop cable comes out of the cable gland on the left. The right-hand cable gland can also be used.

• Connecting to a TSX/PMX PLC with line terminator



The TSX/PMX processor and the TSX FP ACC4 tap are connected using a TSX FP CCxxx drop cable.

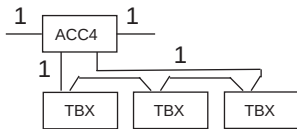
The TSX FP CA/CRxxx trunk cable (on D2) corresponds to the beginning or the end of a segment, the line terminator is at D1 (or vice versa).



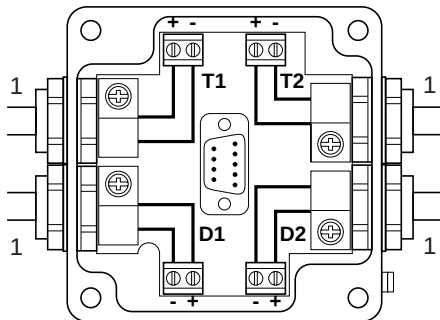
- 1 TSX FP CA/CRxxx trunk cable,
- 2 TSX FP CCxxx drop cable,
- 5 TSX FP ACC 7 line terminator.

(+) corresponds to the red or orange wire,
(-) corresponds to the green or black wire,

- **Extension connected with the TSX FP CA/CRxxx trunk cable**



The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

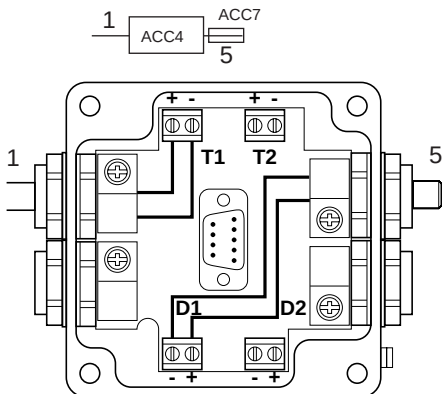


- **Connecting a TSX FP ACC7 line terminator**

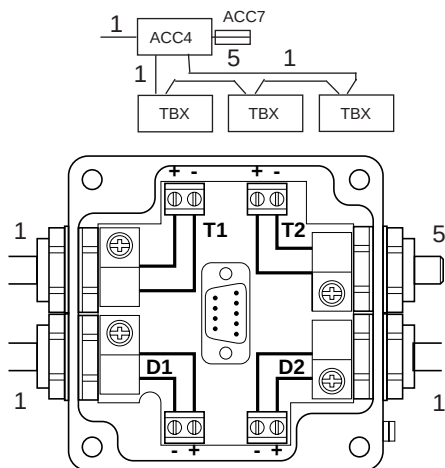
If a tap is located at the beginning or at the end of a segment only the T1 cable is connected and a TSX FP ACC7 line terminator (unpolarized) is connected in place of the second cable segment.

The type of connection depends on whether the drop connection is wired or not, as illustrated in the diagrams below. The user can connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

Tap waiting to be connected



Tap wired as an extension connection



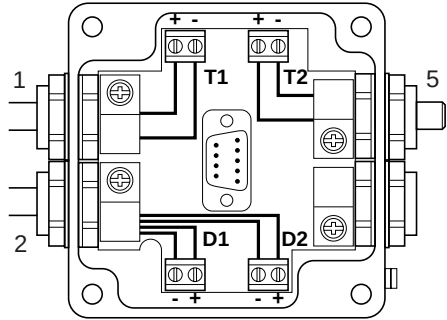
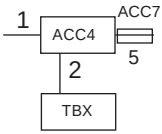
1 TSX FP CA/CRxxx trunk cable,

5 TSX FP ACC7 line terminator,

(+) corresponds to the red or orange wire,

(-) corresponds to the green or black wire.

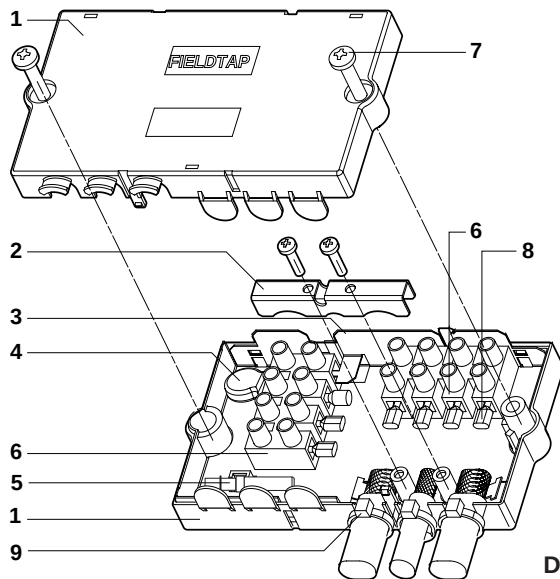
Tap wired as a drop connection



- 1 TSX FP CA/CRxxx trunk cable,
 - 2 TSX FP CCxxx drop cable,
 - 5 TSX FP ACC7 line terminator,
- (+) corresponds to the red or orange wire,
 (-) corresponds to the green or black wire.

3.5-4 Connecting the TSX FP ACC14 taps

This terminal block is used to connect a tap to the trunk cable of a FIPIO fieldbus.

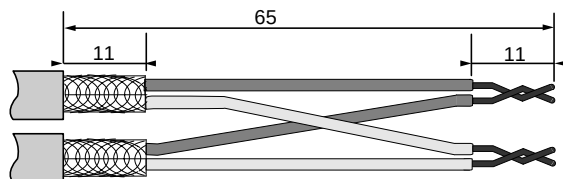


Dimensions : 117x69x26mm
Fixing center : 105mm

- 1 Insulating housing
- 2 Cable shielding guide bracket
- 3 Shielding
- 4 Uncoupling dipole to protective ground, consisting of one capacitor and one varistor
- 5 Line terminator
- 6 Junction blocks
- 7 $\varnothing 4$ fixing screws, $l = 30$ min. (not supplied)
- 8 Double wiring caps
- 9 Cable clamps

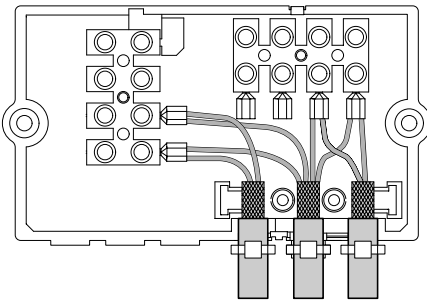
Ensure the stripped parts of the wires are well twisted before they are inserted in the double wiring cap. This ensures the link will not be interrupted if the terminal block is not screwed in fully.

Cable preparation



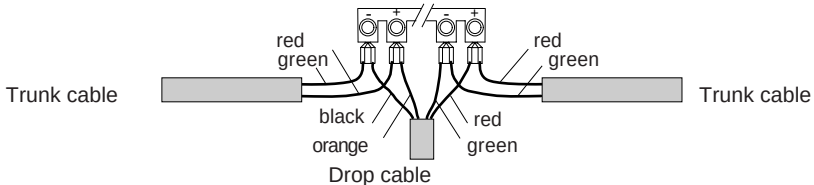
Prepare the trunk and drop cables. Connect them to the junction blocks (6) as explained below, using a 3.5 mm flat blade screwdriver to tighten the connections. If the connection box is at the end of the bus, connect the standardized line terminator (5). The shielding (3) must be connected to protective ground using a conductor with a maximum $\varnothing = 2.5 \text{ mm}^2$, either directly or using an uncoupling dipole. Position the cables with the insulating sheath right up against the edge of the metal shielding (3). Tighten the bracket (2) to provide the electrical connection between the cables and the connection box shielding. Fix the cables in place with the clamps, snap off the tags on the upper cover and clip the cover in place. The connection box is fixed on its support with $\varnothing 4$ screws, $l = 30 \text{ mm}$ minimum.

Connections :



The bracket provides the link between the cable braids and the tap shielding. The drop cable contains two pairs : the connector or device at the other end provides the link between the two pairs. It is therefore important to observe the colors of the respective pairs.

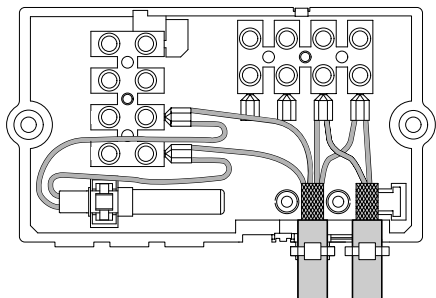
Connecting trunk and tap cables :



Trunk cable with supply pair :

The IBM type 1 cable contains an additional pair for the power supply.

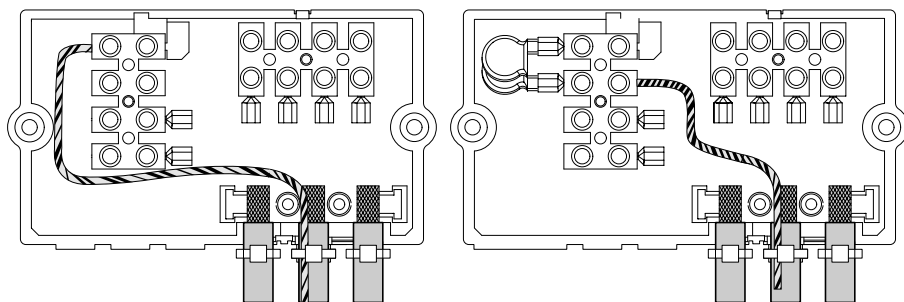
Line terminator :



When the connection box is at the end of a network segment, a line terminator must be fitted on the second pair of the drop cable. To conform with standard IEC 1158-2 a standardized line terminator, TSX FP ACC7 (not supplied) must be used : the box has a slot for this purpose. A clamp is used to secure the line terminator and also to ground the shielding.

Connection to protective earth :

The connection box shielding must be connected to protective ground (P.G.) with a wire $\varnothing 2.5 \text{ mm}^2$ maximum, wired directly or via the dipole. The grounding wire fits into the opening in the bracket provided for this purpose. The dipole (supplied) consists of a 4.7nF capacitor and a varistor in parallel.



3.5-5 Connecting the TBX FP ACC10 Taps

The various cables are connected by means of a screw terminal block. A separate terminal block is used for each twisted pair. The procedure is as follows :

- 1 Open the tap,
- 2 Prepare the cables as described earlier (see section 3.4),
- 3 Remove the card,
- 4 Feed the power cable through the cable gland,
- 5 Connect the protective ground cable to the inside of the connection box (a terminal is provided for this),
- 6 Connect the power cables to the terminal block on the component side observing polarities,
- 7 Replace the card,
- 8 Feed the other cables through the appropriate cable gland,
- 9 Fit a grounding clamp to each cable. The position of the clamp on the cable must take into account where it is secured in the connection box (on the right-hand or left-hand side of the cable),
- 10 Screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+)/Green (-), Orange (+)/Black (-) and pink (+)/blue (-).
FIPIO is connected to the +, - terminal blocks T1, T2, D1, D2
The remote power cable is connected to the +, - terminal block.
- 11 Tighten the grounding clamps and then tighten any cable glands in which a cable or line terminator is located (**tightening torque : 3 Nm for large diameter cable glands, 2.5 Nm for small diameter cable glands**),
- 12 Refit the cover and fasten.

The TBX FP ACC10 tap also has a 9-pin female connector which can be used to connect a TSX FP CG 010 / 030 or TSX FP CE 030 cable.

Caution :

To maintain the protection index (IP65) when TBX FP ACC10 is not fully equipped, it is essential to fit sealing plugs on the cable glands not in use (tightening torque of 1 Nm for cable glands).

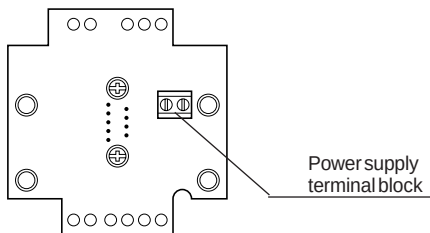
The diagrams on the following pages illustrate the power supply wiring and the various types of connection possible :

- Tap waiting to be connected,
- Drops connected with the drop cable,
- Extensions connected using the remote power cable,
- Connection of a TSX FP ACC7 line terminator.

• Power supply wiring

The power supply terminal block of the connection box is located on the component side of the card.

The remaining terminal blocks used for other types of connections are located on the other side of the card.

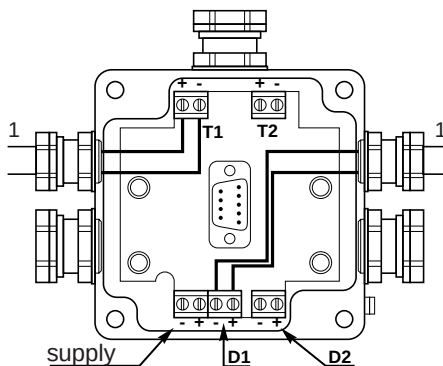


• Tap waiting to be connected

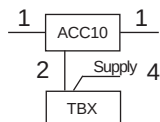


If a tap is waiting to be connected (no TBX wired), the trunk cable must be connected as shown in the diagram opposite. The user can, for example, connect a programming terminal to the SUB-D connector once the quarter-turn cap has been removed.

A TSX FP ACC4 tap can also be used (see section 3.5-3).

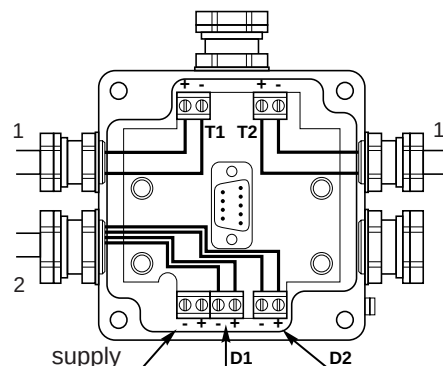


• Drop connected with the TSX FP CCxxx drop cable



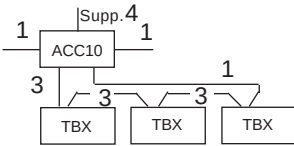
The drop must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed. In the example, the drop cable comes out of the cable gland on the left. The right-hand cable gland can also be used.

A TSX FP ACC4 tap can also be used (see section 3.5-3).

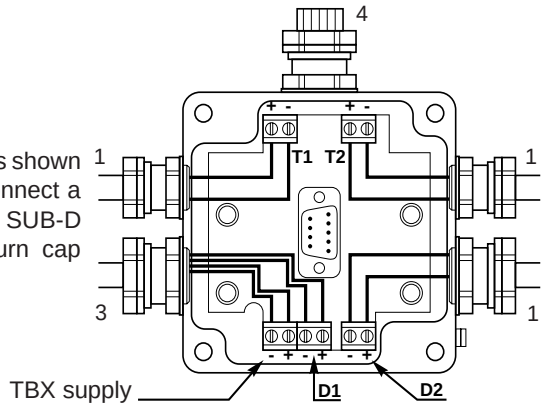


- 1 TSX FP CA/CRxxx trunk cable,
 - 2 TSX FP CCxxx drop cable,
 - 4 Power supply cable,
- (+) corresponds to the red or orange wire,
 (-) corresponds to the green or black wire.

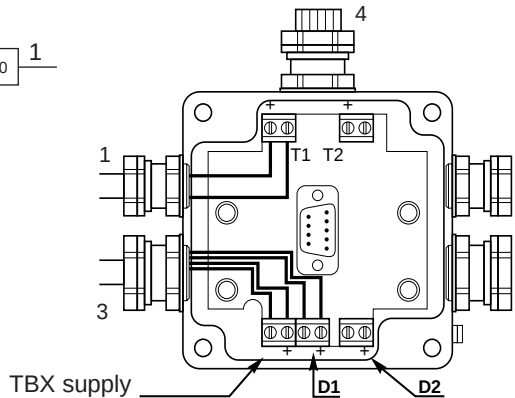
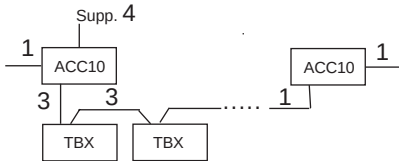
• **Extension 1 connected with the TSX FP CFxxx remote power cable**



The drops must be connected as shown opposite. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.



• **Extension 2 connected with the TSX FP CFxxx remote power cable**



1 TSX FP CA/CRxxx trunk cable,

3 TBX FP CFxxx remote power cable,

4 Power supply cable,

(+) corresponds to the red or orange wire of the FIPIO network for T1,T2,D1,D2 and to the pink wire for power supply to the remote power cable,

(-) corresponds to the green or black wire of the FIPIO network for T1,T2,D1,D2 and to the blue wire for power supply to the remote power cable.

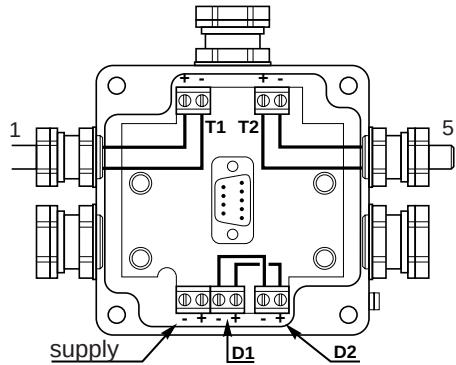
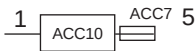
• Connecting a TSX FP ACC7 line terminator

If a tap is located at the beginning or at the end of a segment, only the T1 cable is connected and a TSX FP ACC7 line terminator (unpolarized) is connected in place of the second cable segment.

The type of connection depends on whether the drop is wired or not, as illustrated below. The user can also connect a programming terminal to the SUB-D connector, once the quarter-turn cap has been removed.

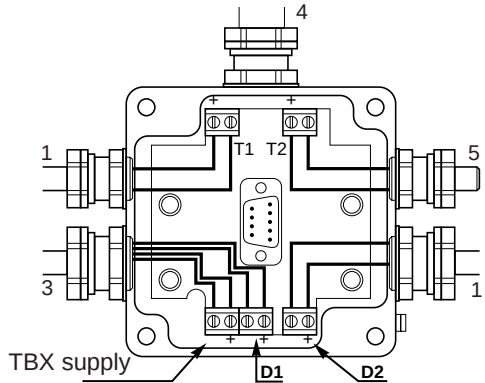
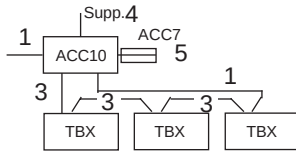
A TSX FP ACC4 tap can also be used (see section 3.5-3).

Tap waiting to be connected

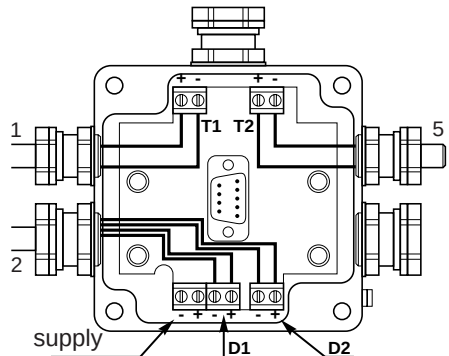
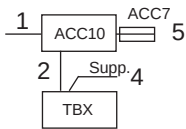


- 1 TSX FP CA/CRxxx trunk cable,
- 5 TSX FP ACC7 line terminator,
- (+) corresponds to the red or orange wire,
- (-) corresponds to the green or black wire.

Tap with extension connection



Tap with drop connection



A TSX FP ACC4 tap can also be used (see section 3.5-3).

- 1 TSX FP CA/CRxxx trunk cable,
 - 2 TSX FP CCxxx drop cable,
 - 3 TBX FP CFxxx drop connection and power supply cable,
 - 4 Power supply cable,
 - 5 TSX FP ACC7 line terminator,
- (+) corresponds to the red or orange wire of the FIPIO network for T1,T2,D1,D2 and to the pink wire for power supply to the remote power cable,
- (-) corresponds to the green or black wire of the FIPIO network for T1,T2,D1,D2 and to the blue wire for power supply to the remote power cable.

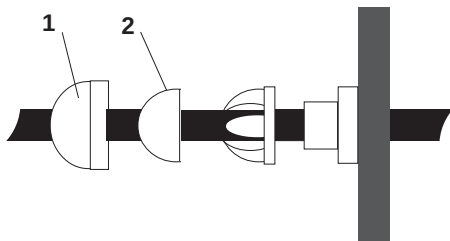
3.5-6 Connecting the TSX FP ACC6 Repeater

C

The various cables are connected by means of screw terminal blocks. For the DC power supply unit, any round cable can be used that is equipped with two or three 2.5 mm² wires. If a shielded cable is used, the shielding should be connected to the terminal with the following symbol $\perp$

The procedure is as follows :

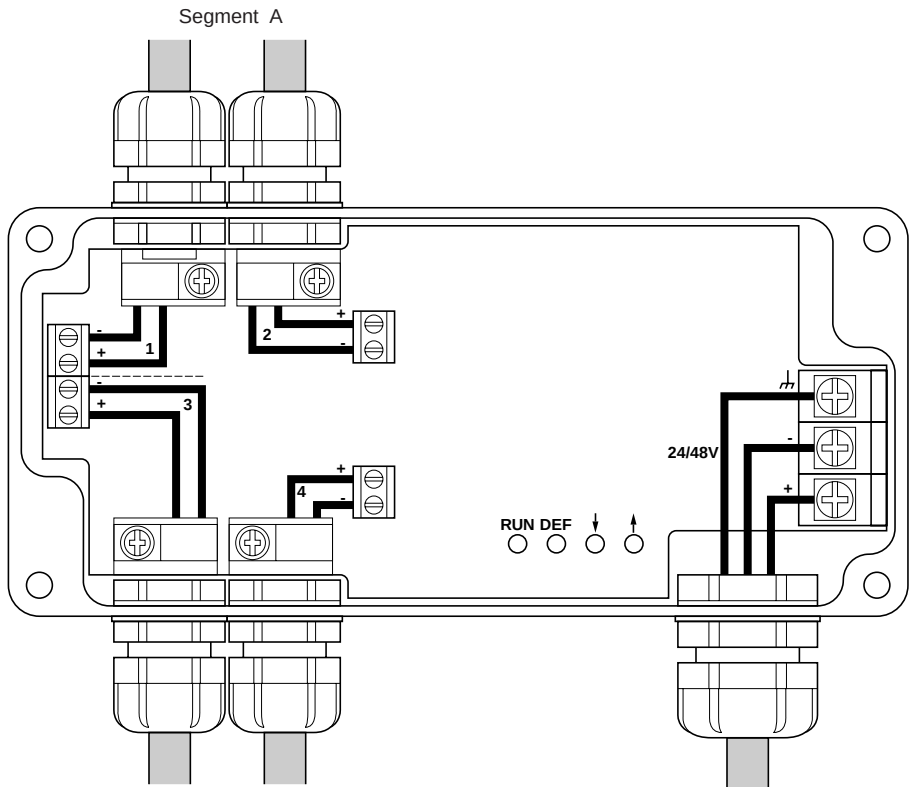
- 1 Open the repeater,
- 2 Prepare the cable glands concerned by cutting the seal **2** inside the nut **1**. Place each cable in a cable gland. If using a line terminator then proceed in the same way. When reassembling take care that all cable gland parts are replaced correctly,



- 3 Prepare the cables as described earlier,
- 4 Mount a grounding clamp on each network cable (shielded twisted pair). The position of the clamp on the cable must take into account how it is secured in the connection box (on the right-hand or left-hand side of the cable),
- 5 Tighten the grounding clamps and then tighten any cable glands which contain a cable, taking great care that the cable does not turn back on itself when tightening the cable gland,
- 6 Screw each wire into the screw terminal block, complying with wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams on the following pages show the different types of connection possible : extension or drop,
- 7 When using a line terminator, attach a grounding clamp to the TSX FP ACC7, tighten the cable gland, and screw each wire into its screw terminal,
- 8 Refit the cover and fasten.

Extension connection

If the repeater is located at the beginning or at the end of FIPIO segment A, only cable 1 is connected. In this case cable 2 must be replaced by a TSX FP ACC7 line terminator. Similarly, if the repeater is located at the beginning or at the end of segment B, only cable 3 is connected and cable 4 is replaced by an unpolarized TSX FP ACC7 line terminator.

C


Segment B

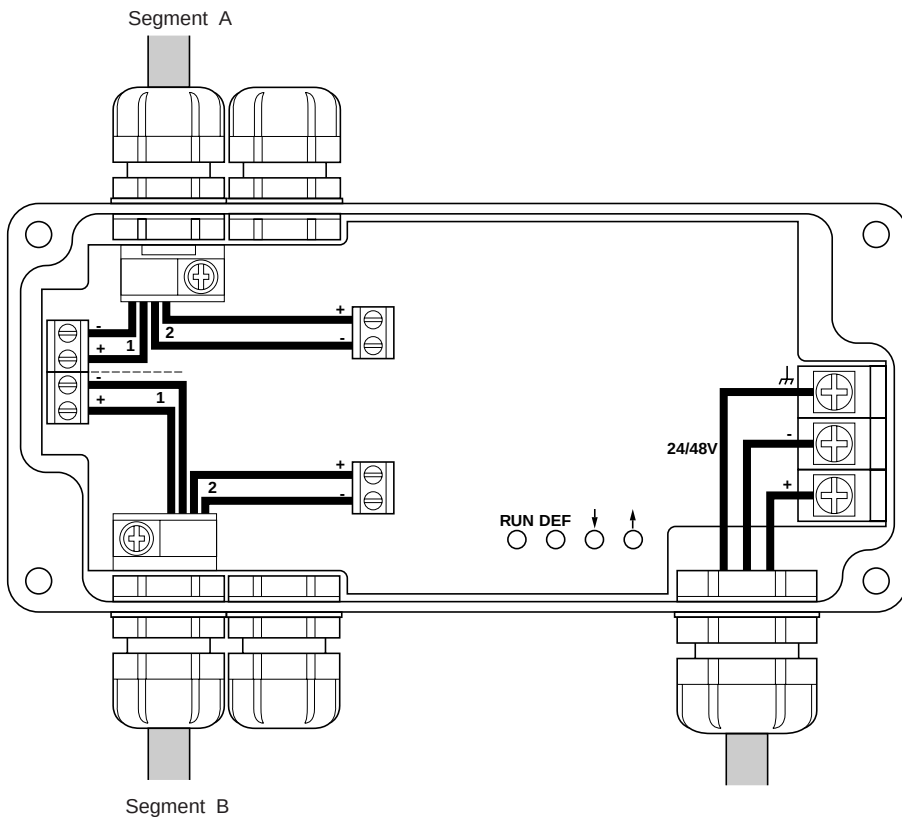
Reminders for FIPIO segments :

(+) corresponds to the red or orange wire,

(-) corresponds to the green or black wire.

Drop connection

For the repeater, this type of connection is made on FIPIO segments A and B by means of TSX FP ACC4 connection boxes. If two TSX FP CA/CR xxx cables are used for one of the drops, the Red and Green wires are replaced by the Red and Green wires of the first drop cable, and the Orange and Black wires by the Red and Green wires of the second drop cable respectively.



Reminders for FIPIO segments :

- (+) corresponds to the red or orange wire,
- (-) corresponds to the green or black wire.

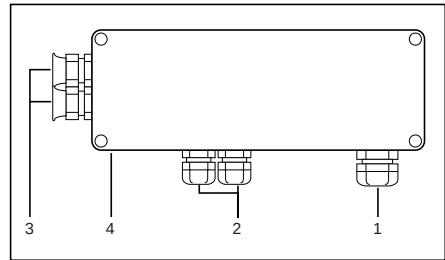
Extension and drop connection

The FIPIO structure allows one segment to be connected by extension and the second one by a drop connection. In this case, the repeater will be installed using a drop connection as in the two examples illustrated above.

3.5-7 Connecting the TSX FP ACC8 Repeater

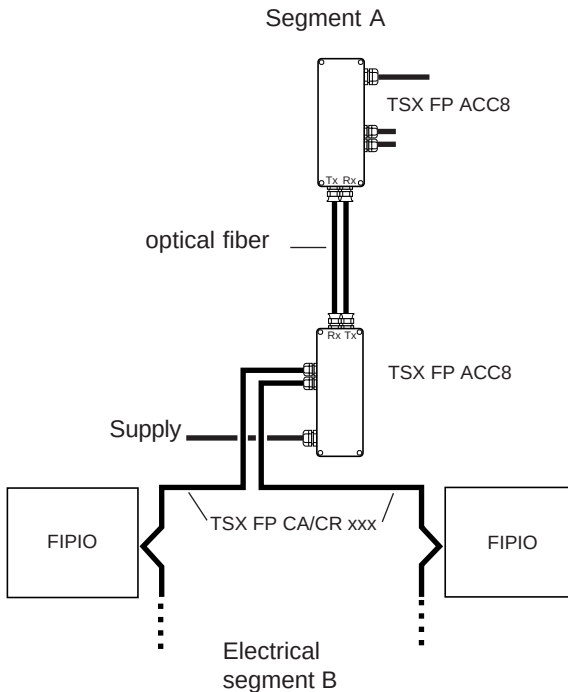
The IP65 dust and damp proof module has 5 cable glands for connection of :

- 1 the power supply,
- 2 electrical segments,
- 3 optical fibers,
- 4 a screw fitted to the exterior which connects the box to the protective ground.



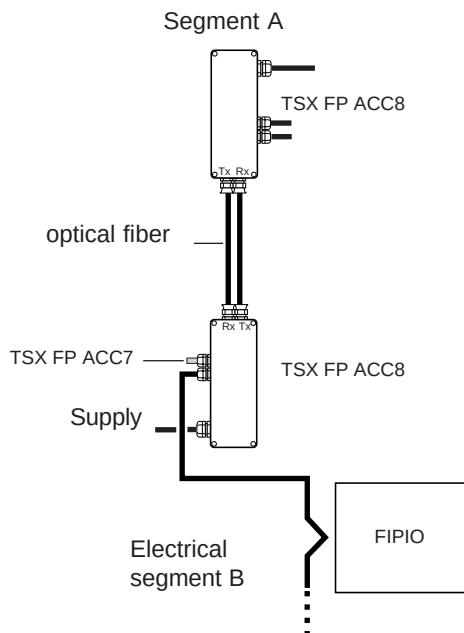
Extension connection

Connection in the middle of the segment :

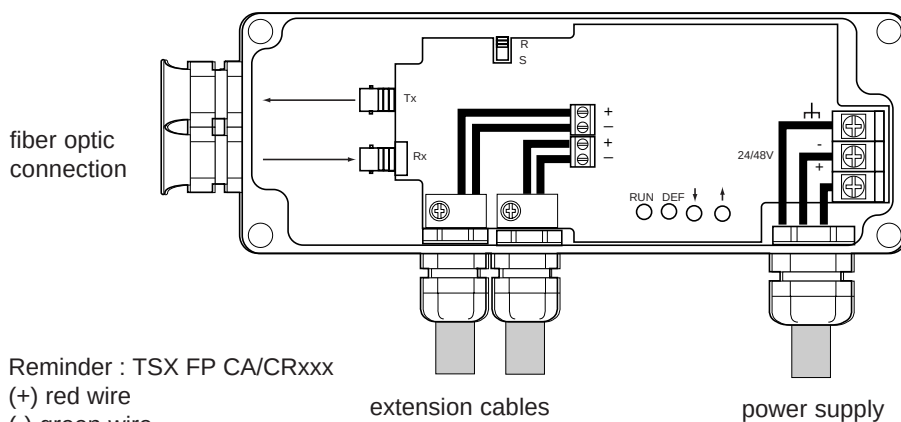


A TSX FP ACC8 repeater always requires a power supply.

Connection at the beginning or end of a segment :



Internal wiring of TSX FP ACC8 repeater in extension mode

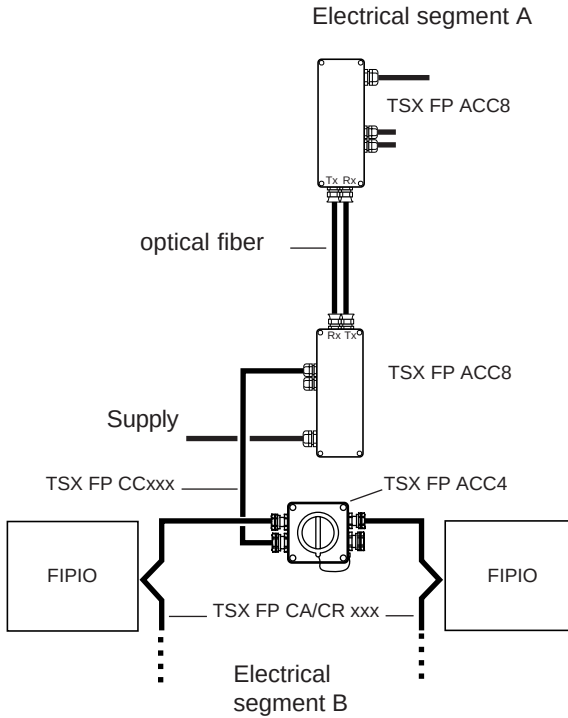


Reminder : TSX FP CA/CRxxx

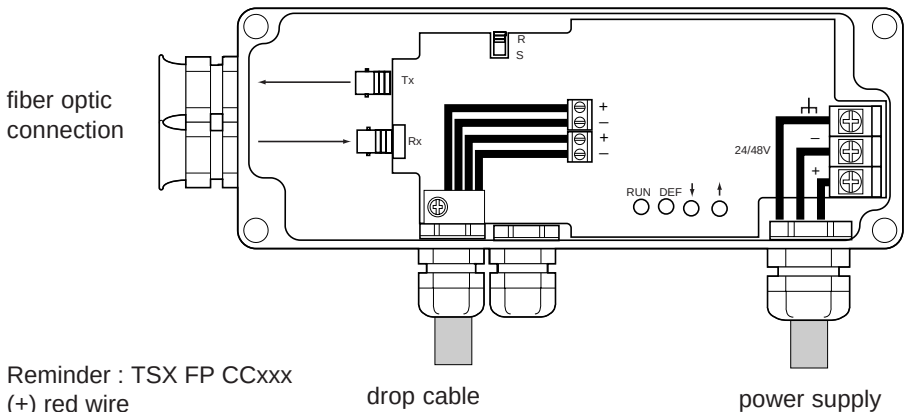
(+) red wire
(-) green wire

A TSX FP ACC7 line terminator must always be fitted at the beginning or end of an electrical segment on one of the extension cable slots.

Drop connection



Internal wiring of the TSX FP ACC8 repeater in drop connection mode



Installing the fiber optic cable

When installing the fiber optic cable, it is necessary to **respect the environmental conditions** specified by the manufacturer and respect the **mechanical stress thresholds** for bending and traction.

It is advisable to **measure the optical attenuation** of the cables **before and after installation** and to check that these stay within the limits specified by the manufacturer.

The mechanical and optical limits of the TSX FP JF 020 cable (jumper cable) are as follows :

- **Bending radius** : always greater than 5 cm,
- **Tensile force** : always below 100 Newtons (10 kg),
- **Attenuation** : always below 1 dB at 850 nm.

Great care must be taken when installing the ST connectors (from the optical or jumper cable) on a TSX FP ACC8 repeater, that the cable is not damaged in any way and that no dust particles are found on the cable which could reduce the quality of the connection. Both connectors are identified by a coupling sleeve (one light and one dark) which enables the appropriate base unit to be selected, which in turn is identified by the light or dark label on the card.

To mount the 2 connectors onto the repeater, proceed as follows :

- 1 Unscrew the 4 fixing screws from the cover and remove it.
- 2 Remove the plastic protection from the first base unit (marked Tx). Dismantle the outside part of the metal cable gland, and then remove the cut metallic washer and the split plastic seal located inside the washer. Remove the small plastic disk from the split seal.
- 3 Slide the outer part of the cable gland, which has just been removed (start with the tapered side), onto the fiber optic cable connector which is fitted with a dark sleeve. Then feed this connector through the fixed part of the cable gland.
- 4 Remove any end protection from the connector and then attach it to the appropriate base unit (marked Tx). When doing this, check that the connector pin is aligned with the slot under the base unit. Holding the connector (not the coupling sleeve) between thumb and index finger, push it towards the base unit and turn it a quarter-turn to lock it.

- 5 Place the split plastic seal around the optical fiber, with the tapered side facing the repeater, and push it into the fixed part of the cable gland. Proceed in the same way with the cut metallic washer, then screw the outer part of the cable gland onto the fixed part. Tighten with a torque of 3 Nm to ensure the module is fully sealed when closed, taking care not to damage the optical fiber by exceeding this value.
- 6 Connect the second optical fiber in the same way : the connector is fitted with a clear coupling sleeve on the Rx base unit.

Note

The fiber optic cable connecting 2 repeaters can be all in one piece, or made up of a maximum of 5 segments, which are equipped with ST type connectors (or of at least equivalent quality). **It is therefore possible to have a maximum of 4 intermediate connections.**

Installing electrical cables

The various cables are connected in the same way as for the TSX FP ACC6 repeater, by using screw terminal blocks, extension or drop connection, taking into account the access to cables 1 and 2, the + and - polarities of the wires and the possible addition of a TSX FP ACC7 line terminator when the repeater is at the end of the electrical segment.

The power supply cable can consist of two or three 2.5 mm² wires and its diameter must be between 8 and 13 mm.

Setup

The TSX FP ACC8 repeater is ready to operate as soon as it is powered up. However, a circuit-breaker which is placed on the electronic card must be set according to how the repeater is used :

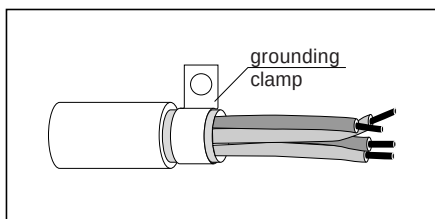
- for a fiber optic connection to another TSX FP ACC8 repeater, the circuit-breaker must be in position **R (Repeater)**,
- for a fiber optic connection to a FIP fiber optic station, the circuit-breaker must be in position **S (Station)**.

3.5-8 Connecting TBX BLP 01 Connectors

C

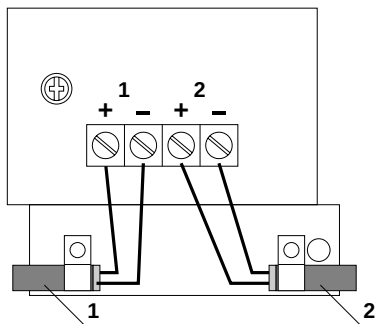
The various cables are connected by means of a screw terminal block. The procedure is as follows :

- 1 Open the connector,
- 2 Prepare the cables as described on the previous pages and then screw each wire into the screw terminal block, observing wire pairing and polarity : Red (+) / Green (-) and Orange (+) / Black (-). The wiring diagrams below show the different types of connection possible : extension or drop connection,
- 3 Secure the grounding clamp(s) in the connector, taking care not to pinch the wires,
- 4 Remove the blanking caps on the cover to expose the cableways,
- 5 Refit the cover and tighten.



Extension connection

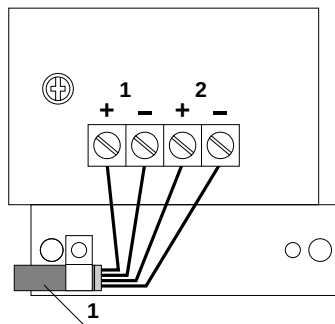
If the device equipped with the connector is placed at the start or the end of a FIPIO segment, only cable 1 is connected to the connection box. In this case, cable 2 must be replaced by an unpolarized TSX FP ACC7 line terminator.



The direction from which the cables arrive is of no importance. They can be installed opposite each other (as shown in the example) or on the same side etc.

Drop connection

In the diagram cable 1 is a TSX FP CCxxx drop cable. If the drop is achieved by 2 TSX FP CA/CRxxx cables, connect in the same way as for extension connection.

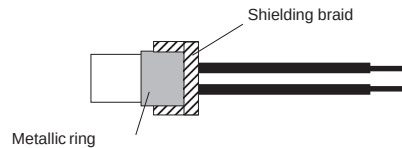
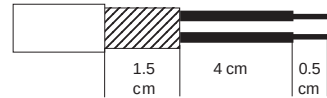


The direction from which the cable arrives is equally of no importance.

3.5-9 Connecting TBX BLP 10 Connectors

The various cables are connected by means of a screw terminal block. The procedure is as follows :

- 1 Open the connector, remove the card and feed the cables through the cable glands,
- 2 Prepare the cables as shown opposite and then screw each wire into the screw terminal block, observing wire pairing and polarity :
Red (D+) / Green (D-) or Orange (D+) / Black (D-) and Pink (+) / Blue (-).
- 3 **Set the address using the switches.**
- 4 Preform the conductors to ease installation of the card.
Remove the cable glands and locate the card in its correct position.
- 5 Place the shielding braid on the metal rings (the aluminium foil shielding is cut as short as possible) and retighten the cable glands (**tightening torque of 3 Nm**).
- 6 Secure the card.

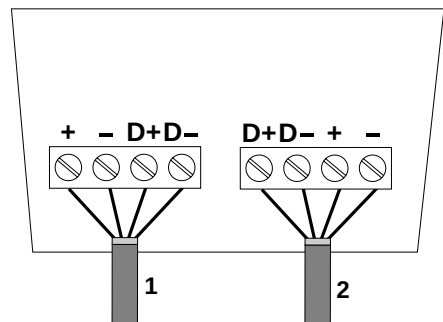


The wiring diagrams below illustrate the various types of connection possible : **extension or drop connection.**

Extension connection

Cable 1 or 2 is a TSX FP CFxxx drop connection and power supply cable.
If the device fitted with a connector is at the beginning or at the end of the FIPWAY segment, only cable 1 is connected to the connection box. In this case, cable 2 must be replaced by a TSX FP ACC7 line terminator (unpolarized), which is connected to D + and D -.

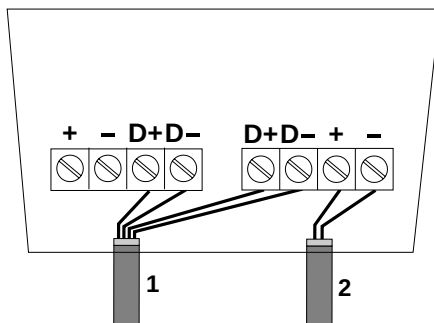
The direction of insertion is not important.



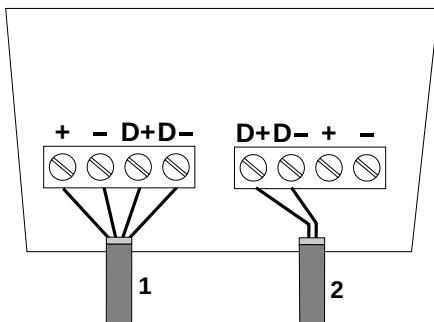
C

Drop connection

Cable **1** is a TSX FP CCxxx type drop cable. Cable **2** is a straightforward power supply cable.



Cable **1** is a TBX FP CFxxx type drop cable, cable **2** is a TSX FP CA/CRxxx type cable.



4.1 General

In order to avoid wiring errors and ensure that the bus will operate correctly, it is advisable to perform certain checks during the installation of each segment :

- Check the electrical continuity of the segment as each wiring accessory is connected : connectors, taps, repeaters,
- Check by ensuring that the bus matching line terminators are fitted properly before connecting the devices,
- Check that the devices are properly connected to the bus before they are powered up.
- If TSX FP ACC6 repeaters are used, the above checks must be carried out individually on each segment. The repeaters must not be powered up during these tests.

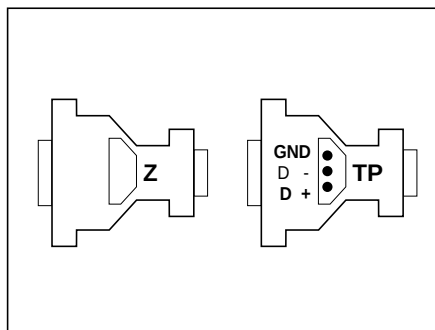
Equipment required

The test procedures described below require an ohmmeter and the TSX FP ACC9 wiring test tool. This tool comprises two modules :

- A Z module which should be connected to the first connection accessory,
- A TP module containing the three test points needed for taking measurements.

Each of these modules is equipped with two connectors (a 9-pin male SUB-D connector and a high density 26-pin female SUB-D connector) that can be connected to the FIPIO wiring system.

- TSX FP ACC9 marked Z
- TSX FP ACC9 marked TP



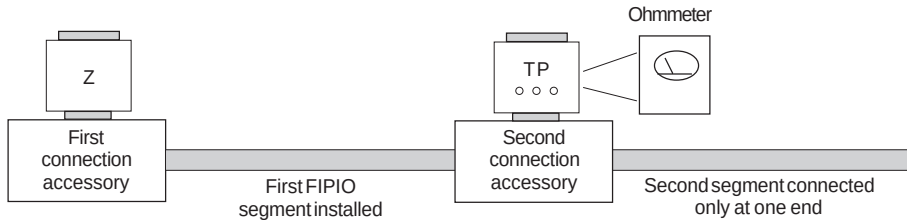
Any faults detected during these tests must be remedied before proceeding with the rest of the installation. The checks required during each installation phase should only be performed if the results of the previous tests are satisfactory.

4.2 Testing Bus Continuity

C

Procedure :

- Wire the first connection accessory (including the shielding) and connect the Z module to it.
- Wire the second connection accessory and connect the TP module to it.



- Using the ohmmeter, measure resistance r_l across the GND and D- terminals of the TP module.

Check that r_l is 500 to 600 Ohms.

If $r_l < 500$ Ohms, there is a short-circuit between one of the wires (D+ or D-) and ground.

If $r_l > 600$ Ohms, the shielding or the D- connector is incorrectly connected.

- Using the ohmmeter, measure the resistance R_H across the GND and D+ terminals of the TP module.

Check that $R_H > r_l$.

If $R_H = r_l$, there is a short-circuit across D+ and D-

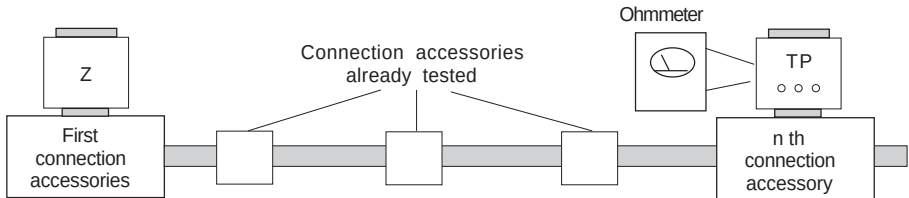
If $R_H < r_l$, the D+ and D- wires are inverted

- Calculate the difference $R_H - r_l$.

Check that this result is 30 to 60 Ohms. If this is not the case, there is a poor contact on one of the wires.

Do not measure the resistance between D+ and D- directly as this measurement will not detect wire inversion.

- If there are several cable segments still to be connected,
 - disconnect the TP module,
 - wire the cable segment and the next connection accessory and then connect the TP module to them,



- repeat each measurement using the procedure described above.

Checking bus continuity when a TSX FP ACC6 repeater is used

The connection of each TSX FP ACC6 repeater should be checked before its cover is fitted. This operation is carried out in two steps :

- At the time the segment connected to channel A is wired, following the procedure described earlier. The measurements are taken with the ohmmeter directly on one of the screw terminal blocks of channel A (the Z module should be connected to segment A),
- At the time the segment connected to channel B is wired, following the procedure described earlier. The measurements are taken with the ohmmeter directly on one of the screw terminal blocks of channel B (the Z module should be connected to segment B).

Checking bus continuity when a TSX FP ACC8 repeater is used

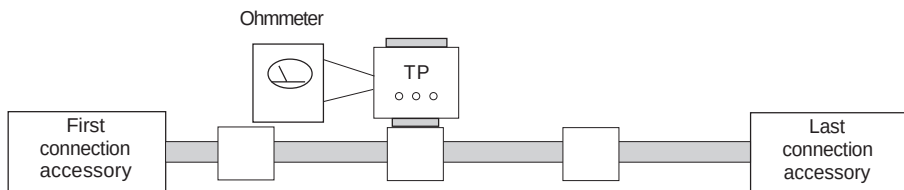
The connection to the electrical segment of each TSX FP ACC8 repeater is checked before its cover is fitted as described above. The measurements are taken with the ohmmeter directly on one of the two small TBX FP ACC8 screw terminal blocks.

4.3 Testing for Line Terminators

C

Procedure :

- A TSX FP ACC7 line terminator must systematically be placed at the beginning and end of an electrical segment. This terminator is connected to the bus via the connection accessory fitted to the end of the segment (at the place where the next cable segment would have been connected if planned). The terminator is not polarized and each wire can be screwed into each of the terminals provided for the cable in any order whatsoever. It must be connected to ground by a clamp or a bar.
- Once the electrical continuity of the segment has been tested (same procedure as above), disconnect the Z module but leave the TP module connected to one of the connection accessories.
- All the stations on the segment must be disconnected during this test.
- Using the ohmmeter, measure resistance R_L (across the GND and D- terminals of the TP module) and resistance R_H (across the GND and D+ terminals of the TP module).



Check that resistances R_L and R_H are within the 450 to 650 KOhm range.

Values that are twice as high indicate that one of the line terminators has not been connected.

Values lower than 450 KOhms indicate that the Z module has not been connected, a station is still connected, or a short circuit.

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1.1 Operating Principles

1.1-1 General

FIPIO and the OSI model

WORLD FIP standards have been drawn up in line with the OSI model of the ISO. This model comprises seven layers, of which only three are required for WORLD FIP.

These are :

7 - application layer,

2 - data link layer,

1 - physical layer.

In addition, the WORLD FIP standard includes a complete description of network management.

The user can only access the upper interface of the communication entity (the user interface of the application layer) through "request, indicate, confirm" exchanges corresponding to communication services.

Operating principle

WORLD FIP is based on the principle of broadcasting information. Data exchange is based on the following :

- the network manager called the bus arbitrator sends a call to all stations. This call is for a producer subscriber and any interested consumers,
- the producer subscriber broadcasts a reply to all stations which can be used by all the consumer subscribers.

All WORLD FIP functions use this type of exchange.

1.1-2 Bus Arbitrator

The bus arbitrator is a function which broadcasts the different identifiers cyclically according to a predefined list.

D

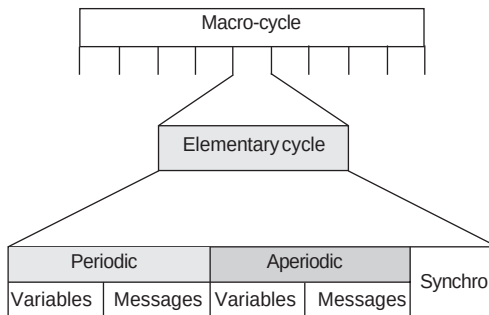
In an application, the variables do not all have to be updated at the same frequency. This list must be organized in such a way to allow, if required, a variable to be called several times within the same cycle in which all the variables are called (macro-cycle).

Some identifiers can be called several times during the same macro-cycle. This will increase the sampling frequency, taking into account the time restrictions imposed by the application.

The duration of the macro-cycle is set and known. The application can therefore determine the exact instant the consumers will have access to a variable.

Each macro-cycle is divided into basic periods of the same duration and structure. These periods are themselves divided into time windows :

- "Variables" and/or "messages" periodic window,
- "Variables" and "messages" aperiodic window,
- Synchronization window.



1.1-3 Periodic Window

The periodic window corresponds to the basic operation of the network. It is based on the following principle :

- Each process variable (integer, real, boolean, character string, etc) is associated with a cyclical identifier,
- Each cyclical identifier is called at least once during a macro-cycle.

When an identifier is sent, the station which must produce the associated variable replies with its value. All basic transactions or transfers are based on the exchange of two successive frames : the bus arbitrator (on its own initiative) sends the name of the variable (identifier) and the producer replies with the value of the variable. The variable is then consumed by each of the stations concerned. All the stations can participate in the transaction.

1.1-4 Aperiodic Window

This window is an extension of the periodic window. It allows the producer to request the following :

- Special interrogation of one or more variables ("variables" aperiodic window),
- Message transmission ("messages" aperiodic window).

These requests are made by the producer or the consumer during the cyclic period while replying to a request it has received.

They are recorded by the bus arbitrator which executes them in accordance with availability in the variable and message aperiodic windows. These windows are located in the same basic period or in the next periods depending on the workload of the network.

"Variables" aperiodic window

The bus arbitrator asks the waiting initiator to specify the list of variable identifiers it wishes to broadcast.

The response is acknowledged by the bus arbitrator which adds the requested identifiers to the normal list of the current period or the next period. This acknowledgment is executed with reference to the time available before the end of the basic period.

When there are several requests the bus arbitrator sorts them, according to priority and order of arrival.

The initiator can be a producer or a consumer of the requested variables or have no relationship at all with the variables.

"Messages" Aperiodic Window

The bus arbitrator "hands over" to the waiting initiator in the selected time window. The initiator sends its message preceded by the target address and the source address. Once the transaction has been completed, it sends an "end-of-transaction" message to the bus arbitrator so the latter can process the next initiator (if the new request will not exceed the time window).

The following types of message are possible :

- Messages with/without acknowledgment (ACK),
- Negative acknowledgment messages (NACK) in broadcast mode.

The protocol defines the characteristics of a message time period and proposes a structure and language that will enable the target to understand the message without requiring any type of initiation.

1.1-5 Synchronization Window

This ensures a constant duration of the basic periods by filling in the dead times (packing).

1.1-6 Network Management

The above information is for a network operating in a steady state. WORLDVIP handles the different phases which combine to achieve this state, such as :

- Configuration : inserts variables, identifiers, parameters, etc into the system
- Setup : performance tests, detects adding and deletion of subscribers, modifies global communication parameters, identifies subscribers, etc,
- Detects and processes faults (traffic monitoring, etc).

All the corresponding functions are divided among the communication entities of the network subscribers, including the bus arbitrator.

1.2 Communication Access

1.2-1 Electing the Bus Arbitrator

WORLDIFIP cannot operate without an active bus arbitrator on the network. On a FIPIO fieldbus, the bus arbitrator is always the PLC at address 0 (default value).

D

1.2-2 Detecting the Presence of a Station

All stations that are part of the network respond cyclically when their own presence variable is scanned. This is how presence of the station on the bus is indicated.

As soon as it is elected, the bus arbitrator checks the presence of all 127 stations that can be connected, and sends the host application the list of stations responding or not responding to their presence variable.

A station that has been recently connected to an operating network with a physical address that is identical to a connected station cannot join the network or the bus. Only those stations declared in the PL7 configuration are checked. Any additional stations connected to the bus will not be detected by the system.

1.2-3 Exchanging Datagrams

Datagrams are exchanged on FIPIO as aperiodic messages.

The number of aperiodic messages which can be exchanged between all the stations is :

- 20 messages of 128 application bytes per second for FIPIO.

1.2-4 Reading and Writing the Remote I/O

I/O are exchanged on FIPIO as cyclical variables.

The scan period depends on the number, type and the task in which each I/O module is declared. It is calculated when the I/O configuration is generated in PL7 and then sent to the PLC processor when the program is transferred.

PL7 ensures that each input/output is updated before the end of the task period in which it has been configured.

1.3 Selected Parameters

1.3-1 FIPIO Parameters

Physical layer

- CH conformance class,
- S2 speed,
- No remote power supply,
- Grounding : equipotential grounding network.

1.3-2 TSX FP ACC8 Fiber Optic Repeater Parameters

Physical layer

- cs_62,5+ conformance class,
- S2 speed,
- No remote power supply,
- Grounding : equipotential grounding network.

1.4 Cable Characteristics

1.4-1 TSX FP CA xxx Trunk Cable

Main characteristics

- Diameter = 7.8 mm $\pm$ 0.2 mm with two 22-gauge wires,
- Diameter on metal braid = 6.4 mm $\pm$ 0.2 mm,
- Composed of one twisted pair matched to $140 \Omega < Z_c < 155 \Omega$,
- Attenuation at 1 MHz - 12 dB/Km,
- Linear resistance at 20°C - 52 Ω /Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius = 75 mm,
- Can be used in the factory for voltages less than 36 V,
- Storage temperature : -25°C to + 70°C,
- Operating temperature = +5°C to + 60°C,
- Flame tests to UL VW-1 standard,
- Applicable test standards : IEC 189-1 and IEC 885-1,
- Complies with French standard NFC 46-604,
- Use inside a static installation. Usage criteria : see table in section 3.

1.4-2 TSX FP CR xxx Flexible Trunk Cable

Main characteristics

- Diameter 8.6mm max, 2 AWG 22-gauge wires
- One twisted pair matched to : $Z_C = 150 \Omega \pm 10\%$ (3 to 20 MHz)
- Bending radius (dynamic) : 65 mm
- Metal braid and inner insulation shielding,
- Storage temperature : -40°C to + 70°C,
- Operating temperature : +5°C to + 70°C,
- Vertical flame test
- Flame resistant
- Applicable test standards : IEC 885-1
- Complies with French standard NFC 46-604
- Resistance to oils,
- Resistance to hydrocarbon,

-
- Resistance to solder splashes,
 - Ultraviolet resistance,
 - Resistance to saline atmospheres,
 - Resistance to 100% humidity,
 - Usage criteria : see section 3

1.4-3 TSX FP CF xxx Flexible Remote Power Trunk Cable

Main Characteristics

- Diameter = 9.5 ± 0.3 mm with two AWG 22-gauge wires (FIPIO), and two AWG 18-gauge wires (power supply),
- Composed of one twisted pair matched to $140 \Omega < Z_c < 155 \Omega$,
- Attenuation at 1 MHz - 12 dB/Km,
- Linear resistance at 20°C - 52 Ω /Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius :
 - static = 10 times the diameter,
 - dynamic = 20 times the diameter.
- Can be used in the factory for voltages less than 36 V,
- Storage temperature : -25°C to + 70°C,
- Operating temperature : - 10°C to + 70°C,
- Flame test to UL VW-1 standard,
- Flame resistant : NFC 32-70-C2
- Applicable test standards : IEC 885-1,
- Complies with French standard NFC 46-604,
- Resistance to oils, CNOMO standards
- Resistance to hydrocarbon,
- Resistance to solder splashes, NFC 32510
- Ultraviolet resistance,
- Resistance to saline atmospheres,
- Resistance to 100% humidity,
- Usage criteria : see table in section 3

1.4-4 TSX FP CC xxx Drop Cables

Main Characteristics

- Diameter = 7.8 mm $\pm$ 0.2 mm with four 26-gauge wires,
- Diameter on metal braid = 6.4 mm $\pm$ 0.2 mm,
- Composed of two twisted pairs matched to $140 \Omega < Z_c < 155 \Omega$,
- Attenuation at 1 MHz - 17 dB/Km,
- Linear resistance at 20°C - 135 Ω /Km (static),
- Metal braid and inner insulation shielding,
- Minimum bending radius = 75 mm,
- Can be used in the factory for voltages less than 36 V,
- Storage temperature : -25°C to + 70°C,
- Operating temperature = +5°C to + 60°C,
- Flame tests to UL VW-1 standard,
- Applicable test standards : IEC 189-1 and IEC 885-1,
- Complies with French standard NFC 46-604,
- Use inside a static installation. Usage criteria : see section 3.

D

1.4-5 Fiber Optics

Fiber optic links are not provided. The TSX FP ACC8 repeater uses fibers with the following characteristics :

Type : Multimode silicon fiber

Data rate : 1 Mb/s

The characteristics of each link depend on the type of fiber optic used :

Type of fiber (2 fibers per data link)	Attenuation	Guaranteed dynamic range	Length allowed for 1 segment (2)	Maximum number of segments
62.5/125 fiber	4 dB/km	18 dB	0 to 3 km	5
50/125 fiber	3 dB/km	12.5 dB	0 to 2.5 km	5
100/140 fiber	5 dB/km	5.5 to 21 dB	1 to 3 km	5

(2) while retaining an initial margin of 3 dB and assuming a loss of 3 dB for the connections.

D

Acknowledgment

Response frame indicating that a data frame has been received correctly. FIP protocol only manages the concept of acknowledgment at link level.

Bridge

A device that interconnects two network segments or two networks in a transparent manner at data link layer level. Addressing continuity is ensured between two segments both before and after the bridge

Bus arbitrator

A FIP element which controls the access rights to the medium of each information producer. There must only be one active bus arbitrator in FIP at a given moment.

Control field

In a transmitted frame, the part that specifies the type of information exchanged and the type of exchange.

Cyclic scan of variables

A function carried out by the bus arbitrator consisting of cyclic exchange of variables, which is the basic principle of FIP.

Datagram

A structured data packet that transits through the network. Each data packet is a separate entity on the network.

Driver

A program included in the operating system that executes transmission/reception requests via a specified peripheral. A driver is dedicated to a peripheral. It will not interpret messages read or written.

Drop cable

The cable connecting a station to a tap.

FIPIO standard profiles

FRDP : FIPIO Reduced Device Profile

FSDP : FIPIO Standard Device Profile

FEDP : FIPIO Extended Device Profile

Flow (data rate)

The transmission capacity of the medium expressed in bits/second (b/s).

Frame

A group of bytes sent over the network containing data or check information.

Gateway

D

A device that interconnects any two types of network. It acts as an interface at application layer level. A gateway performs address and/or protocol conversions enabling communication between stations on different stations.

Identified consumed variable

Local concept for a FIP entity. It indicates that the variable corresponds to an identifier on which the entity will receive a data item.

Identified produced variable

Local concept for a FIP entity. It indicates that the variable corresponds to an identifier from which the entity will transmit a data item.

Identified variable

FIP variable with an associated identifier.

Identifier

A 16-bit word associated with a variable for the unique characterization of this variable in a FIP system.

Identifier frame

Data sent by the bus arbitrator to assign the medium to each information producer.

ISO

International Standards Organisation.

Layer

A layer is a set of services that perform a function as defined by the ISO in their OSI model for distributed systems. A layer provides an access interface and uses the interface provided by the layer below it.

- | | |
|------------------------------|---------------------------|
| • Layer 1 : Physical, | • Layer 5 : Session, |
| • Layer 2 : Data Link Layer, | • Layer 6 : Presentation, |
| • Layer 3 : Network, | • Layer 7 : Application, |
| • Layer 4 : Transport, | |

Line terminator

A component that is connected to the ends of a segment to ensure that a matching impedance is maintained.

Management information base

A set of data to be managed in a network. Some of the information contained in this base concern a particular layer but the exchange protocol and format are always at application layer level.

Medium

Usually refers to the complete wiring system : cables, connectors, taps, etc.

Multiple network

A network architecture comprising several segments connected by bridges (Series 7 PLCs only).

Protocol

A set of rules required to ensure that various elements, often remote, can establish and maintain data exchanges.

Response frame

Data sent by the information producer as a response to an identifier frame. This data is sent to all consumers.

Scan table

A table containing all the identifiers. Scanning these variables constitutes the FIP macro-cycle.

Series 7

A specific Schneider Automation application service that receives and transmits datagrams on the network (text function blocks, UNI-TE requests, programming requests, debugging, adjustments etc.).

Slot time

The maximum time that a station which has finished sending must wait to detect transmission by the next station.

Station (Device)

A device connected to a segment. A station can exchange data with other stations. It has a unique address on the entire network.

STD_P

Family of devices which conform to the FIPIO standard profiles.

TAP

A device for connecting one or more stations to the network via the trunk cable.

Triggered scan of messages

A function carried out by the bus arbitrator enabling aperiodic message transfers.

Triggered scan of variables

A function carried out by the bus arbiter enabling aperiodic variable transfers.

Trunk cable

Cable that connects two stations together in extension mode.

UNI-TE

The Schneider Automation proprietary message handling service that provides a single communication interface for all Schneider Automation components and those from other vendors that support UNI-TE. It comprises a list of standard requests based on a Client/Server concept providing the following services :

- Management of variables,
- Management of operating modes,
- Bus and device diagnostics,
- Up/downloading of files and programs.

3 TSX ACC6/ACC8 Repeaters - Additional Information**3.1 Architecture with TSX FP ACC6/ACC8 Repeaters**

Information and wiring for TSX FP ACC6 / 8 repeaters are available in section C of this manual.

D

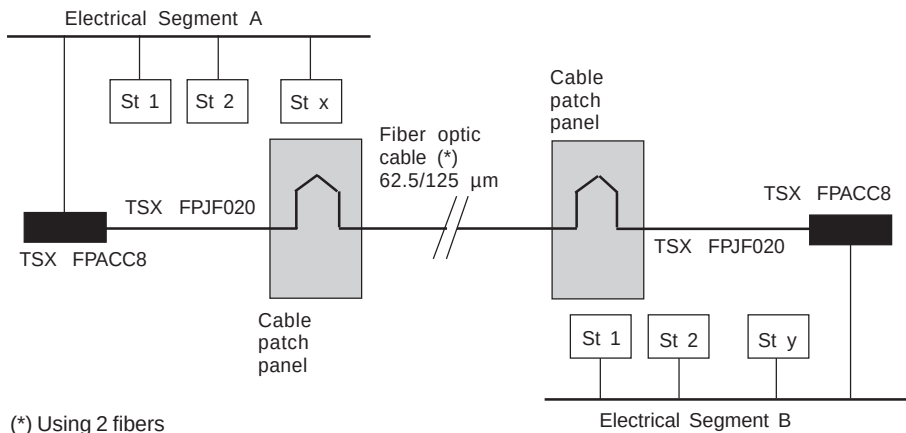
3.1-1 Repeaters between FIPIO Electrical Segments

Using two TSX FP ACC8 repeaters and a fiber optic segment (two fiber optic cables) will extend the length of the FIPIO network and increase the number of physical connection points (a maximum of 128 connection points can be logically managed).

Each electrical segment comprising a shielded twisted pair, with a characteristic impedance of 150 Ohms (TSX FP CA/CFxxx or TSX FP CCxxx cable) is limited to a length of 1000 meters (the equivalent of a "trunk cable") and is fitted with a TSX FP ACC7 line terminator at each end.

3.1-2 Repeaters Between FIPIO Electrical Segments with Fiber Optic Patch Panel

D



3.2 Network Topology

Using "fiber optic/electrical" and/or "electrical/electrical" repeaters enables the following network topologies to be set up :

- **linear**, to increase the total network length (up to a maximum of 15 kilometers) and/or the number of connection points (up to a maximum of 128 logical connections),
- **tree** or **star**, to cover large areas (one or two Km²) and to increase the number of connection points (up to a maximum of 128 logical connections),
- **mixed**, for a compromise between the total network length and the area covered. The number of connection points is also increased (up to a maximum of 128 logical connections).

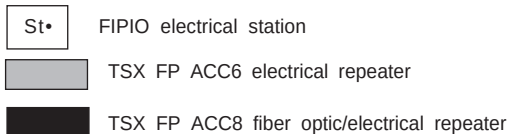
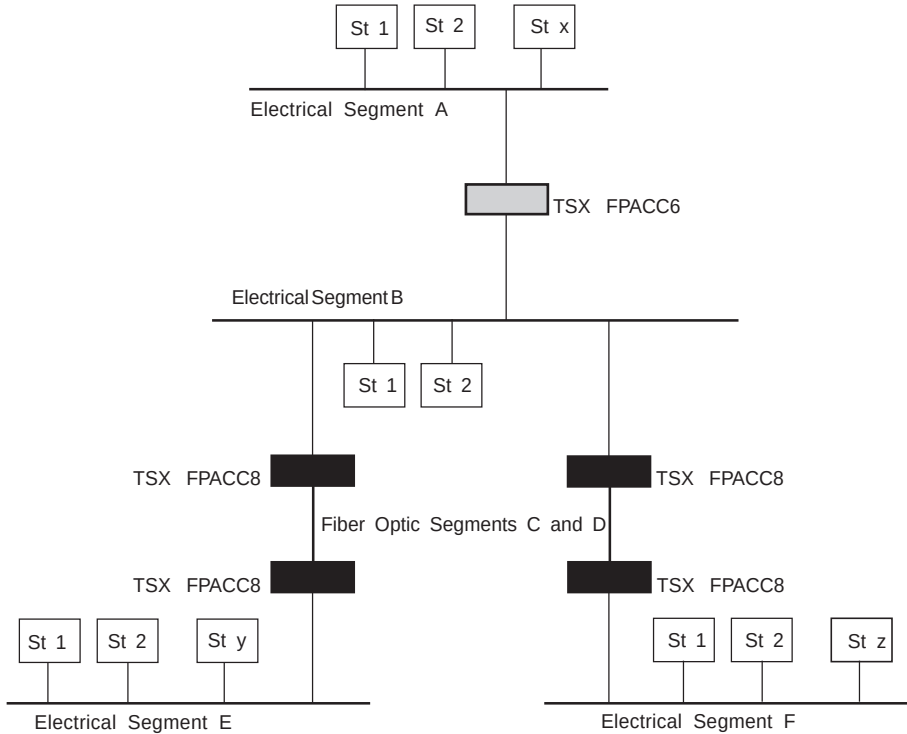
D

3.2-1 Topology Guidelines

- A segment is restricted to 32 stations, a FIPIO architecture to 128 stations,
- A TSX FP ACC8 fiber optic/electrical repeater can be located at any point on an electrical segment,
- TSX FP ACC8 fiber optic/electrical repeaters can co-exist in the same network architecture with TSX FP ACC6 electrical/electrical repeaters,
- It is possible to connect up to 32 stations and 4 repeaters (TSX FP ACC6/ACC8) per electrical segment. However, the number of repeaters can be increased to a total of 32, as long as the number of stations on the segment is reduced by the same amount (for example, 28 stations, 4 TSX FP ACC6 repeaters and 4 TSX FP ACC8 repeaters).

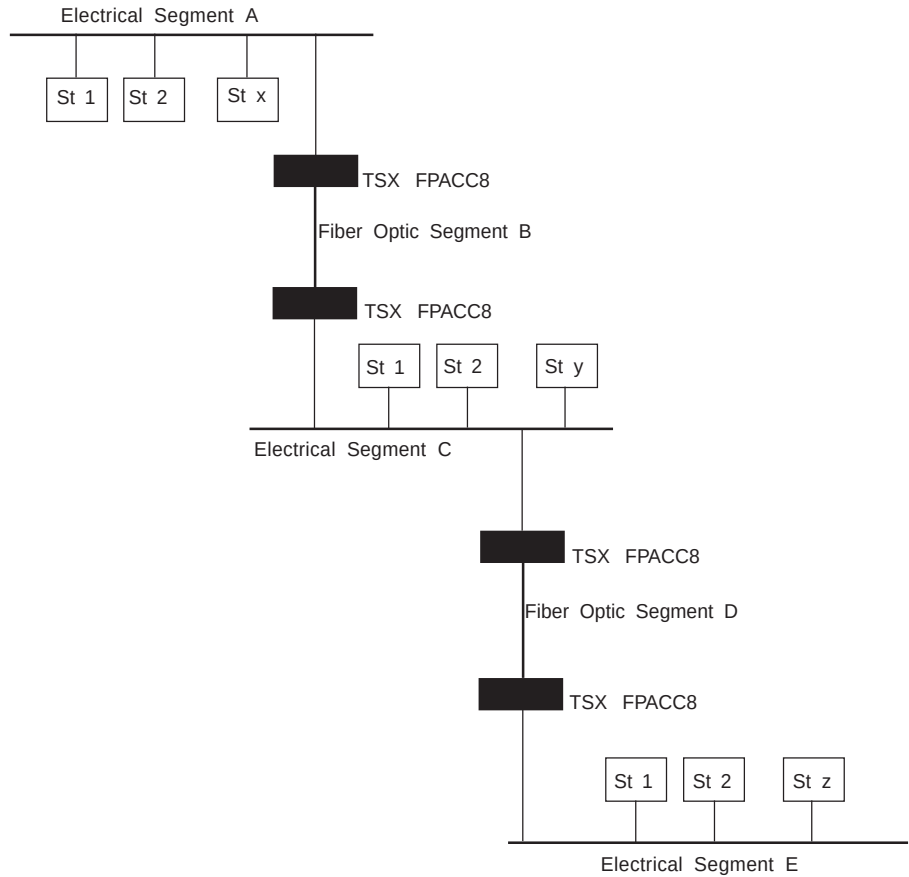
3.2-2 Example 1 : Star Structure

4 electrical segments A, B, E, F and 2 fiber optic segments C, D, with 1 TSX FP ACC6 electrical repeater and 5 TSX FP ACC8 fiber optic repeaters.



3.2-3 Example 2 : Linear Structure

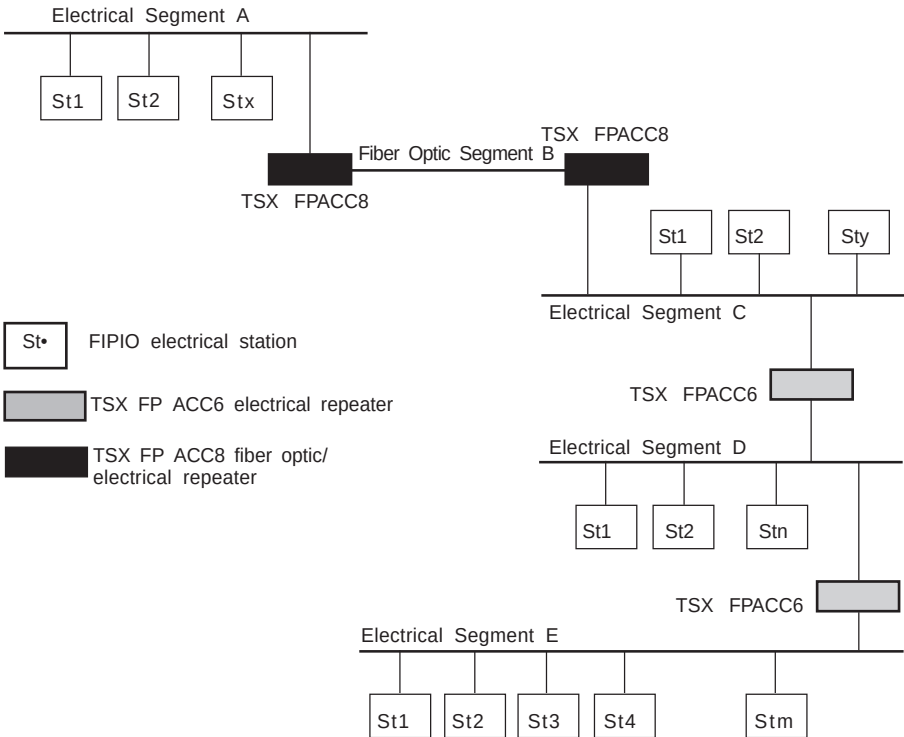
3 electrical segments A, C, E and 2 fiber optic segments B, D, with 4 TSX FP ACC8 fiber optic/electrical repeaters.



D

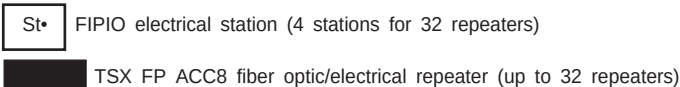
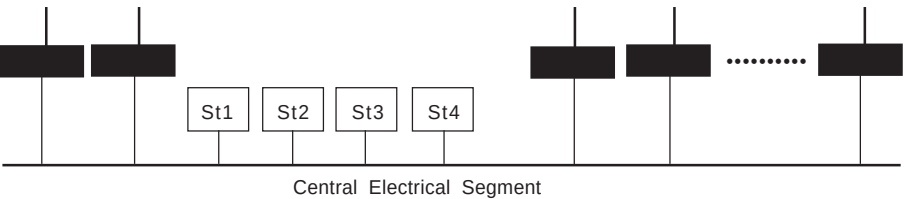
3.2-4 Example 3 : Mixed Structure

4 electrical segments A, C, D, E and 1 fiber optic segment B with 2 TSX FP ACC6 electrical repeaters and 2 TSX FP ACC8 fiber optic/electrical repeaters.



3.2-5 Example 4 : Star Structure

1 electrical segment with n fiber optic/electrical repeaters.



3.3 Using the Indicators on TSX FP ACC8 Repeaters

RUN LED : this indicator lights as soon as the repeater is powered up.

↑ or ↓ LEDs : when activity is detected on one (and only one) of the two (fiber optic or electrical) segments connected to the repeater, it will start to send the regenerated data from the active segment to the second segment. The LED corresponding to the transmission direction (electrical to fiber optic or fiber optic to electrical) will then light until the segment which was initially active becomes inactive (or until an error is detected). Generally, data exchanges are performed alternately in both directions, giving the impression that the two ↑ and ↓ LEDs are always lit.

When using a link to a FIP fiber optic station and if the activity is detected as originating from this station, the data is also sent back to the sender station.

If the two segments become active simultaneously, the repeater remains in reception mode only, until one of the two segments ceases to be active.

DEF LED : this indicator lights during normal operation to indicate an error caused by :

- The repeater itself,
- An external failure, generally a "talkative" device (one that sends a frame longer than that which is allowed by the FIP standard).

To determine the cause of the error, power down or disconnect all other devices from the FIPIO network. If the DEF LED remains lit, the repeater is faulty and must be returned for repair. Otherwise, power up the various devices one by one, starting with the repeaters and thus locate the device which caused the error.

3.4 Characteristics and Performance Levels

FIIPIO Network

Maximum number of devices per electrical segment (a device is either a station or a repeater)	36
Maximum number of stations managed logically	128

The maximum length in km of cable (electrical or fiber optic) between the 2 stations furthest apart (including the bus arbitrator station) is $22 - (0.5 \times R)$: where R is the number of repeaters (electrical or fiber optic) crossed by the FIP data between these 2 stations.

Note : this rule only concerns architectures based on Premium bus arbitrator stations (TSX 57xx2, TPMX 57xx2 or TPCX 57xx2) and TSX FP ACC6 electrical and TSX FP ACC8 fiber optic repeaters.

Multimode Silicon Fiber Optic Segment

Binary data rate	1 Mb/s
Typical or maximum transit time for a repeater	2.2 μ s

Characteristics of each data link according to the type of optical fiber used :

Type of fiber (2 fibers per data link)	Guaranteed dynamic range	Length allowed for 1 segment (2)
62.5/125 fiber 4 dB/km	18 dB	0 to 3 km
50/125 fiber 3 dB/km	12.5 dB	0 to 2.5 km
100/140 fiber 5 dB/km	5.5 to 21 dB	1 to 3 km

(2) Example with an initial margin of 3 dB and a loss of 3 dB for the connections.

TSX FP ACC8 Fiber Optic / Electrical Repeater

Electrical signals (peak-to-peak levels)

• reception	min. 0.7 V	max. 9 V	distortion < 20 ns
• transmission	min. 5.5 V	max. 9 V	
• conductor/ground electrical isolation (50 Hz, 1 min)		1500 V rms.	

Optical power levels (peak) at 850 nm, measured on a 62.5/125 mm fiber

• reception	min. -30 dBm	max. -10 dBm	distortion < 20 ns
• transmission	min. -12 dBm	max. -10 dBm	
	extinction ratio	> 13 dB	

Power supply

• voltage (DC)	min. 19 V	max. 60 V	under 19 V : 210 mA
• current in normal operation	under 48 V : 80 mA		
• primary/ground electrical isolation	(50 Hz, 1 min)	1500 V rms	

Protection against EMI (to IEC 801.3)	level 3 (10 V/m)
Protection against ESD (to IEC 801.2)	level 4
RF rejection	EN55022 class A

Protection level	IP65
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Operating temperature	min. 0 °C max. 70 °C
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External dimensions (in mm)	L 254 x H 100 x D 78
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Approximate weight (in kg)	1.5
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